GAS

JULY 1959

Streamlining meter change-outs

A CHILTON PUBLICATION

THE NATION'S NATURAL GAS AUTHORITY

ROCKWELL ALUMINUM METERS

WHEREVER YOU NEED BIG CAPACITY AT LOW PRESSURE

—AT SHOPPING CENTERS, MOTELS, SCHOOLS, ETC.,

YOU CAN USE THIS METER WITH PROFIT

ROCKWELL "750" Single Joint ALUMINUM METER

It's "made to measure" for you!

Light in weight, the Rockwell "750" is easy to carry and easy to install. Set this workhorse meter inside or out. The sturdy, pressure cast case resists weathering as well as the knocks and bumps that endanger meters made of thinner gauge materials. Repairs are a cinch, too. There's only one joint to break and all working parts can be lifted and replaced as a unit. For catalog describing the "750" and our complete line of aluminum meters, write to Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

Capacity: 750 cfh at ½" pressure differential

Weight: only 47 lbs.

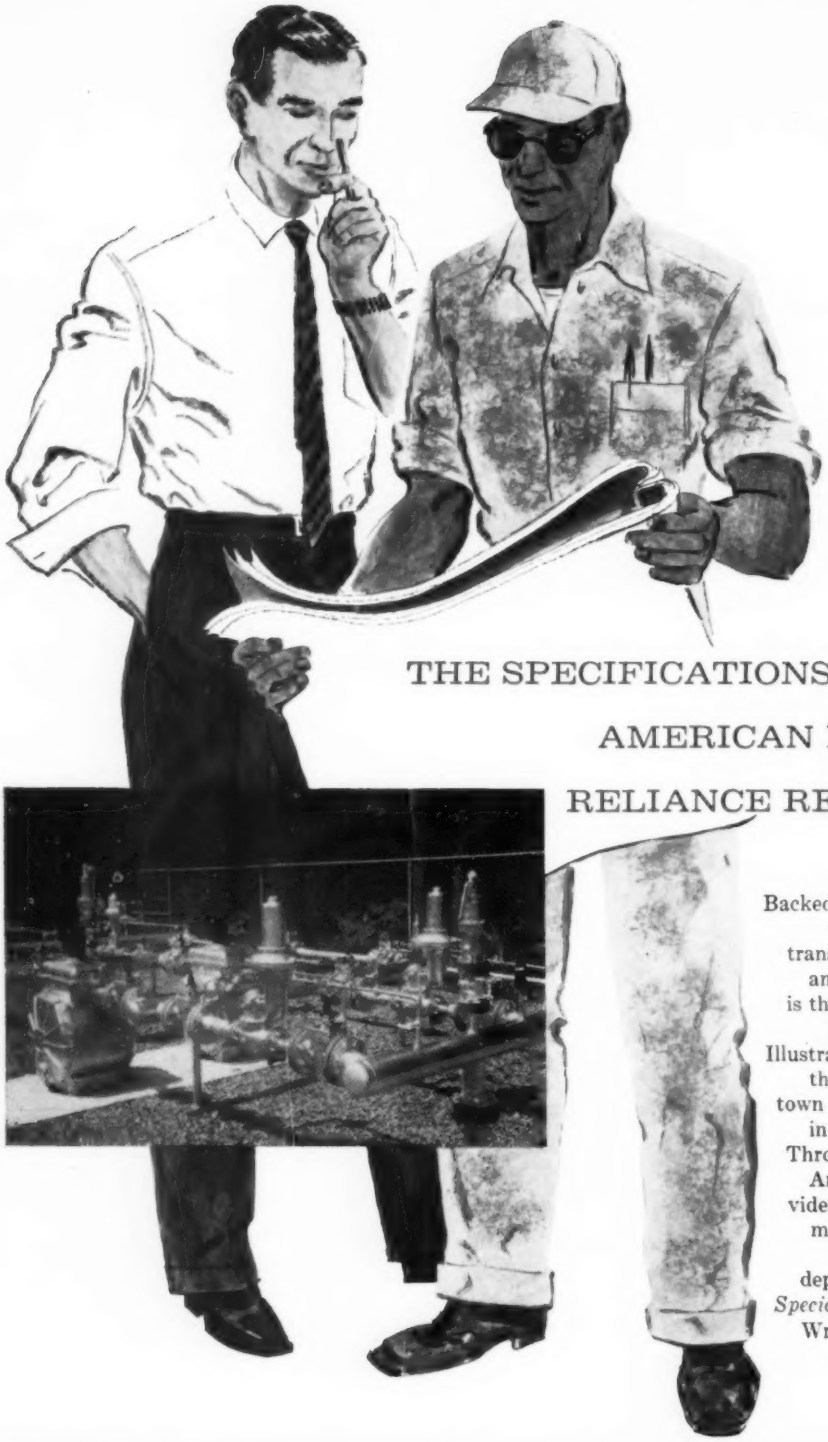
ALUMINUM GAS METERS

another fine product by

ROCKWELL

The only complete line of ALUMINUM METERS

Be sure and see Playhouse 90, GEM sponsored TV program . . . Check your local paper for time and station.



THE SPECIFICATIONS CALL FOR AMERICAN METERS AND RELIANCE REGULATORS

Backed by the judgement of many of the country's leading gas transmission authorities, American and Reliance precision equipment is the standard for accuracy and dependability.

Illustrated is one of the hundreds of these efficient gas transmission town border installations you'll find in all parts of the country.

Through vast networks of pipelines, America enjoys the services provided by gas—controlled and metered by *Reliance* and *American* for safety, accuracy and dependability.

Specialists in Measurement and Control

Write for bulletins containing complete specifications.

AMERICAN®
METER COMPANY
INCORPORATED (ESTABLISHED 1836)

AMERICAN METER CO MEASUREMENT ENGINEERS

RELIANCE
REGULATOR DIVISION
ALHAMBRA, CALIFORNIA

use MUELLER® NO-BLO® Methods to stop-off lines SAFELY under pressure!

to repair leaks
to tie-in lines and loops
to replace and install equipment

All of these operations are done quickly and economically by isolating a section of line with Mueller Line Stopper Fittings and Equipment.

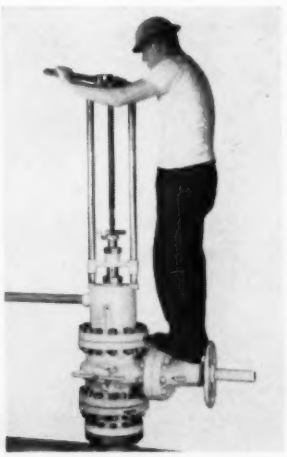
Shown below is the simple step-by-step method developed by Mueller Co. to get fast, effective stop-offs in any line. By making two pressure stop-offs at once and using a by-pass line, a section of line can be completely isolated without interrupting the flow of fluid.

A by-pass connection, built into the body of each stopping machine, makes it easy to install a temporary by-pass line with a minimum investment in time and materials. This detail of design is typical of the attention to detail in research, design and engineering that becomes a part of every Mueller product.

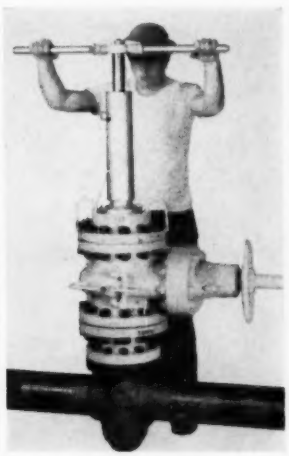
Mueller Line Stopper Fittings and Equipment may be used on lines up to 12" in size, under various pressures as high as 500 p.s.i. on most models and temperatures to 250° F. Write for complete information.

Step 1. Weld fittings to line. Bolt gate valves to fittings.

Step 2. Bolt Mueller Drilling Machine to valve. Cut-out sections of line to accommodate stopper. Remove drilling machine.



Step 3. Bolt stopping machines to valves. Connect by-pass. Stop-off line. Section of line now isolated — ready for repair, replacement or tie-in.



Step 4. Remove stopping machines and by-pass. Install completion plug in top of fitting with completion machine.

Step 5. Remove all equipment. Cap fittings.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario

GAS

CONTENTS

JULY 1959

35TH YEAR OF PUBLICATION

VOLUME THIRTY-FIVE · NUMBER 7

FEATURES

Production line methods applied to meter changes..... 63
By James Webb

Evaluating company needs for electronic data processing, Part 2 67
By H. H. Bockstege Jr. and W. M. King Jr.

Heating an 'unheatable' building 71

Stream analyzers—A continuous approach to improving control, Part 2 74
By D. J. Fraade

A guide to training servicemen: 3. Gas air conditioners.... 78
By J. A. Hayes

New gas repair 'package' demonstrated 82

PIPELINE SECTION

Universal pressure distribution in gas pipelines..... 111
By D. O. Atkinson and Paul B. Crawford

Surveying pipeline routes by radar 118
By Maurice E. Fuller

Installing and testing recording calorimeters..... 122
By S. M. Keehn

Rubber sphere removes loose debris from line..... 127
By R. O. King

DEPARTMENTS

Editorial Comment—

Thermally Thinking, *by J. Fred Ebdon* ... 6
Highlights 8
Regulatory and Legislative Trends 11
Technical Trends, *by Guy Corfield* 15
Washington, *by Neil Regeimbal* ... 21
Corrosion Prevention, *by Marshall Parker* .. 23
Communications, *by Frank Chapman*... 144

News Developments—

Colorado coal mine tested for storage 84
Gas heating customers up 6 per cent in '58..... 84
FPC overrules examiner in Trunkline case 131
Hudson crossed in record time 131
Pakistan may export gas 132

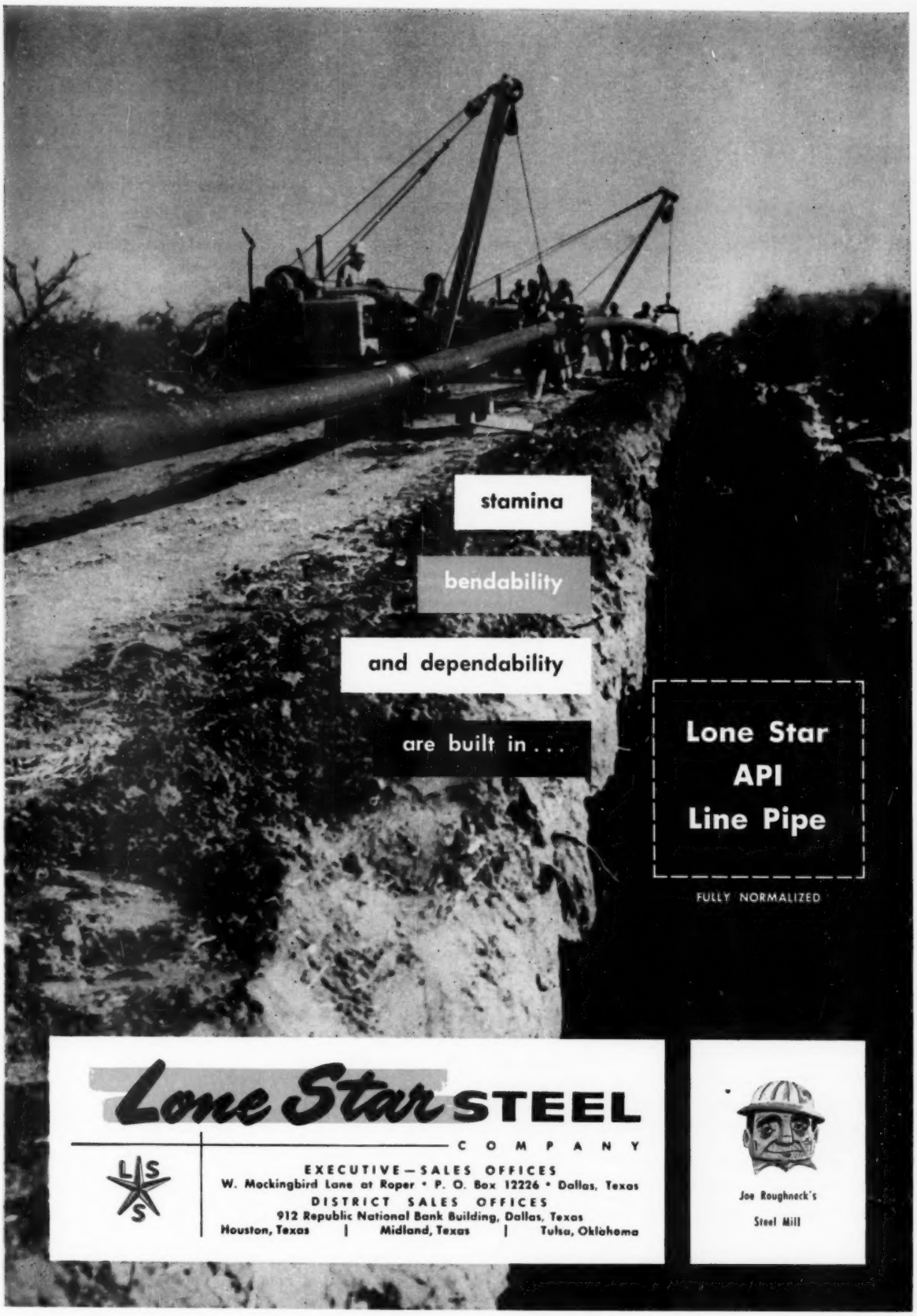
Departments—

Digest of New Products and Trade Literature. 88
Associations 99
People 103
Calendar 140
Pipeline People 151
Advertisers Index 158

BPA

GAS is published monthly. Copyright 1959 by Chilton Company, 56th and Chestnut Streets, Philadelphia 39, Pa. Subscription price: United States and possessions and Canada (in advance): one year, $2.00; two years, $3.00. Mexico, South and Central America, Caribbean Area: one year, $3.00; two years, $5.00. All other countries: $10 per year.
Accepted as controlled circulation publication at Philadelphia, Pa. Members: Business Publications Audit of Circulation, Inc., National Business Publications, Inc. Gas is indexed regularly by Engineering Index Inc. The name "GAS" is registered U. S. Patent Office.

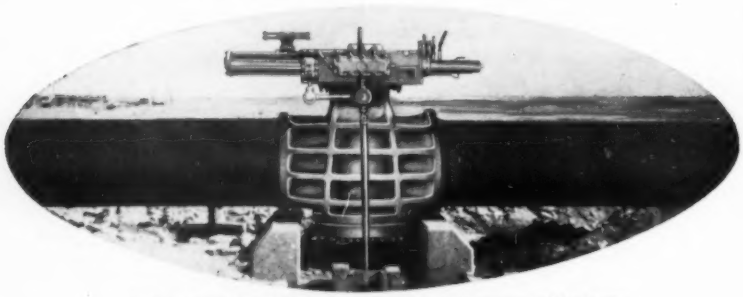
NBP


stamina
bendability
and dependability
are built in . . .
Lone Star
API
Line Pipe
FULLY NORMALIZED
Lone Star STEEL
COMPANY
EXECUTIVE—SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma
Joe Roughneck's
Steel Mill

Ledeen Gate Valve Operator with integral gas powered hydraulic oil system mounted on buried main line block valve.

Ledeen VALVE OPERATORS

FOR THE GAS INDUSTRY



Ledeen Quad Plug Valve Operator with auxiliary manual hydraulic control on compressor station block valve.

Whether you use gate or plug valves in your large gas lines, Ledeen has one of the most complete lines of operators and controls available for their automatic operation.

No matter what size valve is involved, write or call Ledeen for engineered recommendations.

Ledeen MFG. CO.

3334 No. Gilman Road
El Monte, California

CUmberland 3-3163

WRITE FOR BULLETIN 3010

GAS

A CHILTON PUBLICATION
198 S. Alvarado St., Los Angeles 57
Tel. DUnkirk 7-4337

Frank Chapman, Publisher

J. Fred Ebdon, Editor

Don Wright, Managing Editor
William T. Harper, Eastern Editor
Barbara Hall, Assistant Editor

Guy Corfield, Technical Editor
Neil Regeimbal, Washington Editor
Raymond A. Grote, Art Director
Robert Gunning, Readability Consultant

Gilbert Bowman, Promotion Manager
Mary Lou Dorian, Production Manager
Gerald N. Smith, Circulation Manager

ADVERTISING OFFICES

New York (17)
Richard Duffy
100 E. 42nd St.
OXford 7-3400

Cleveland (15)
Frank J. Enright
930 B. F. Keith Bldg.
1621 Euclid Ave.
SUperior 1-2860

Chicago (1)
Richard L. DeMuesy
360 N. Michigan Ave., Suite 418
RAndolph 6-2166

Dallas (6)
Harold E. Mott
189 Meadows Bldg.
EMerson 8-4751

San Francisco
Frank McKenzie
Merchandise Mart
1355 Market St.
UNderhill 1-9737

Los Angeles (57)
Jack Kay
198 S. Alvarado Street
DUnkirk 7-4337

G. C. BUZBY, President

Vice Presidents: P M. Fahrendorf, Robert E. McKenna, Leonard V. Rowlands, George T. Hook. Treasurer, William H. Vallar; Directors: Maurice E. Cox, Frank P. Tighe, Everit B. Terhune, Jr., Russell W. Case, Jr., John C. Hildreth, Jr., Chas. A. S. Heinle, John H. Kofron.

Stanley Appleby, Comptroller

Sherman's 1959 Panther Power Digger

with All New Loader Attachment

The improved Panther blends feature knowledge from over 17,000 installations with the imagination and skill of Sherman's research and engineering.

Go Ahead! Compare! Sherman is the Standard of Comparison!

- ★ Exclusive Sherman Hydra-Loop provides hydraulic power at both ends of tractor simultaneously.
- ★ Lightning Detach frees tractor for other jobs in two minutes without special tools.
- ★ Dirty Filter Indicator guarantees maximum all-around performance.
- ★ Easy oil filter accessibility saves time, eliminates work, simplifies maintenance.
- ★ 2800 Sherman dealers throughout U. S. and Canada assure you of prompt parts and service for dependable and economical operation.

AND . . . for the first time, the all new Sherman Loader is available as companion equipment. With 2000 lbs. lift, 4000 lbs. breakaway capacities. (2500 lbs./5000 lbs. for Ford Industrial or Fordson Power Major tractors.) The improved Panther and new Loader give you an excavating-materials handling unit that outperforms, outmaneuvers any comparable equipment on the market today!

SHERMAN S PRODUCTS

POWER DIGGERS • LOADERS • SOIL WORKING TOOLS

SHERMAN PRODUCTS, INC.

Royal Oak, Michigan

See Your Ford Tractor Dealer Today

SHERMAN PRODUCTS, INC.
3200 W. 14 Mile Rd., Royal Oak, Mich.

Please send me Bulletin No. **494** on the Sherman Panther Power Digger and All New Loader.

Name_____

Address_____

City_____ State_____

GAS

JULY 1959

Thermally Thinking

LAST month while you were reading here about me being in Argentina I was, in fact, back in Los Angeles with my feet on my desk. As mentioned before, this is exactly where my boss, Frank Chapman, and Chilton Co. do not want my feet.

Our beautiful trip to Argentina developed into a clinker, at least for the time being. How sad it makes us (in more ways than one) to report that we got no closer to Buenos Aires than the bar at Club Maxim in Houston, Texas (no charge for that, Camille). We came so close to making it but, carramba, we missed.

The day before we were due to board our plane for the Pampas, it seems that some of the boys south of the border started whooping it up in an explosively strenuous fashion. In B. A. they turned-to with a zealousness that produced assorted flying objects ranging from bullets to over-ripe produce. Some of the local-color boys must have become pretty well carried away because in about the third stanza of the evening's frolic several street cars were overturned and burned.

Actually, such boisterous demonstrations are not really serious in the eyes of old South American hands. Most of these rather frantic forms of expression don't mean very much when you are used to them; however, we are not at all used to them. Such bashes are something of a favorite sport in most parts of Latin America. But political athletics of this type are not my forte.

We would have persevered in spite of these initial pyrotechnics. We waited away some days in Houston with hopes that the water would clear. But, worse luck, there was attrition of more deteriorative factors into the picture. The best advice we could gain from extensive counsel was—stay the hell out of Argentina for awhile.

Never having been Congressional Medal of Honor timber, we very demurely quit Houston for our mountainside home in La Cañada, Calif. Here, we have nothing to worry about except earthquakes, landslides, runoff water, and high flying hubcaps or low flying automobiles (your choice) on the Pasadena Freeway.

So, we have unpacked our "working clothes" and tucked away for future use our U. S. Passport; immunization slip known as the "yellow card"; a "police letter" asserting that we are not wanted for any reason by the Sheriff of Los Angeles County; 10 copies of our passport picture; and a letter from a doctor stating that we are mentally competent—we'll never let go of that document.

A problem now: How do we give back and get a refund on $47-worth of shots? Our blood currently flows swimming with agglutinins, antitoxins, and precipitins that were to guard us from smallpox, typhus, typhoid, tetanus, and yellow fever. For awhile our arms felt like they had been tattooed.

Also hors de combat are bottles of bug oil and snake bite elixirs; some Mother Sill's travel pills; and over 100, count 'em, pills which are the travelling man's best friend. The latter are delightful pellets that not only cure but prevent Central and South America's special gift to the wayfaring wonderer, the galloping touristas.

Seriously, we are sincerely sorry that conditions prevented us from making this trip and bringing you this story. But we will not give it up; just set it aside for the time being. Perhaps before too long matters will have arranged themselves more favorably.

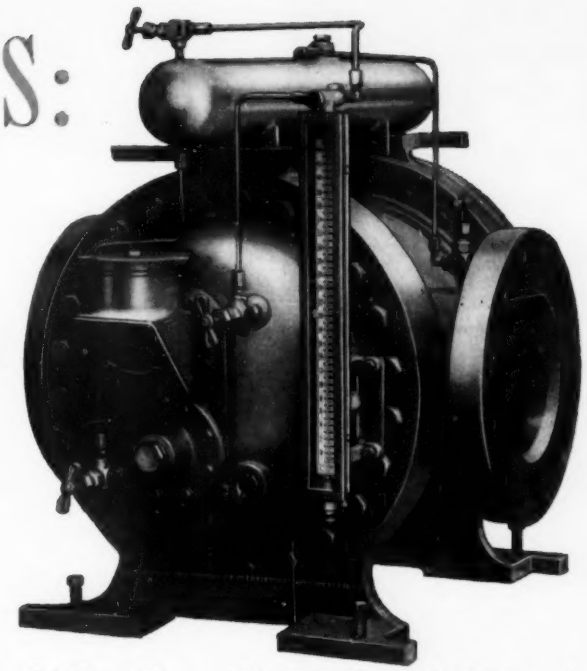
In the interim, I am doubtful that our feet will stay on the desk very long. Things just don't work that way in this game. We'll be off again in a swirl of jet blast in July, if not before, to bring you stories of gas industry developments.

"Eye Witness Editorial," that's our forte. At least we *try* to get our stories from where they happen rather than from convention floors.

J. Fred Ebsen
EDITOR

R-C PRESENTS:

a new line of high-pressure rotary gas meters



FOR 600 PSIG SERVICE

A new line of 600 psig rotary positive displacement gas meters has been developed by Roots-Connersville to serve the needs of industries requiring extreme measurement accuracy in the higher pressure ranges. The meters are available in 4 sizes covering a range of from 84,000 to 1,600,000 scfh.

THIS NEW METER LINE IS IDEAL FOR MANY APPLICATIONS:

- City Gate Metering
- Transmission Line Metering
- Process Gas Metering
- Chemical Gas Manufacturing
- Gas Lifting
- Compressor Stations
- Well Head Measurements
- Steel Mills
- Underground Storage
- Metering of pulsating flow and surges, H2, 02, C02, NH3, LP gas, NO, He, C2H2, etc.

R-C rotary gas meters require an absolute minimum of maintenance . . . assure almost complete freedom from wear . . . exceptionally high accuracy in metering. A refinement of the basic R-C rotary-positive design which has proved its dependability over the years. These new meters for 600 psig service have incorporated simple in-the-line mounting, straight through flow . . . high-speed gears . . . and a welded steel outer case enclosing a steel inner cylinder. Throughout their extra wide operating range, these new R-C meters assure greater accuracy and improved performance in handling a wide variety of gases.

The development of this new meter is another example of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

Write us for additional information and data sheets about these new Roots-Connersville meters for 600 psig service.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
759 Oregon Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto

GAS HIGHLIGHTS

SoCounties-Richfield decision due soon

A decision is expected soon from the California PUC in the dispute between Southern Counties Gas Co. and Richfield Oil Co. over what should and what should not be considered a public utility. Richfield has built a 30-in. pipeline from the San Joaquin valley to a Southern California Edison Co. steam plant near Oxnard, to supply natural gas for use as boiler fuel. SoCounties contends that Richfield has become a public utility by building and operating the pipeline, and should come under PUC regulation. Richfield disagrees, and built the line without seeking PUC certification. Regardless of forthcoming decision, the case seems destined to wind up in U. S. Supreme Court before it is finally closed.

Louisiana gathering tax ruled illegal

Louisiana's gas gathering tax has been declared unconstitutional by a state district court. The court ruled, in a suit brought by Southern Natural Gas Co. and three other producers, that the gathering tax violated a section of the state constitution which provided that only severance taxes should be levied on oil, gas or sulfur leases. The state, which had been receiving $40 million annually from the gathering tax, plans an appeal to Louisiana Supreme Court.

Field tests start on new gas refrigerator

Norge division of Borg-Warner Corp. has started field testing a new gas refrigerator. Norge officials say if tests go as expected, they will have the 11-cu ft box in mass production this fall. Norge President Judson S. Sayre says the refrigerator will be marketed nationally through "87 distributors and hundreds of utilities."

Forced air furnace generates own electricity

AGA Laboratories researchers have completed a demonstration model forced-air furnace which generates its own electricity to operate the warm air circulating fan. Employing the thermoelectric principle, the small scale prototype furnace is entirely self-contained and requires only gas for operation.

Utility makes big step toward automation

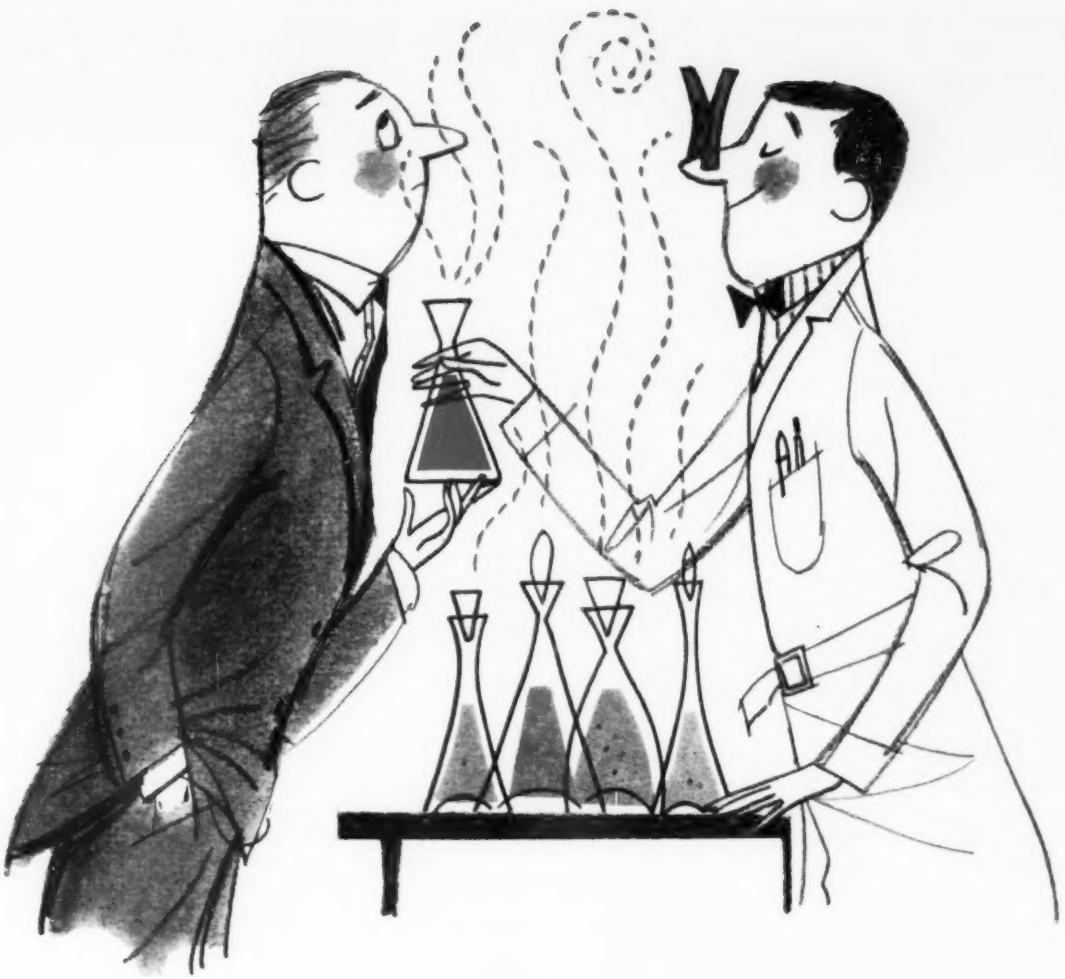
Public Service Co. of Colorado will install the gas industry's first computerized system for on-line gas dispatching control. Installation of the system, which will monitor gas flow meters at purchase points throughout Public Service's service area, will begin in September. It will be put into operation in October. Data supplied by the computer will be used to control demand peaks to avoid high contract demand rates. The system was designed by GPE Controls, Inc.

Municipal advocates face investigation

Los Angeles City Council has ordered an investigation of an organization which has been advocating municipal ownership of the gas systems serving the city. The organization, which calls itself the "Municipal Assembly of Los Angeles," has in recent weeks carried on a $10,000-plus newspaper advertising campaign urging the possible acquisition by the city of the Southern California and Southern Counties Gas Co's. distribution systems within the city. City Council now wants to know who is behind the movement, and what the group's motives are.

Florida deliveries begin; additional gas sought

Natural gas arrived in Florida June 1, culminating a five-year effort of Houston Corp. and its subsidiaries to serve the state. Even before the first deliveries had been made by the combined system of Houston Texas Gas & Oil Corp. and Coastal Transmission Corp., the two Houston Corp. subsidiaries had applied to FPC for authorization to expand pipeline capacity to 338 MMcf per day—a boost of 60 million daily.



Let our man fit an odorant to your needs

Oronite has a number of odorization specialists whose jobs are to serve the gas industry. These men have tackled just about every conceivable kind of odorization problem and type of application.

They know that practically every odorization condition is somewhat different and are most willing to work with you in adapting an Oronite odorant to your individual needs.

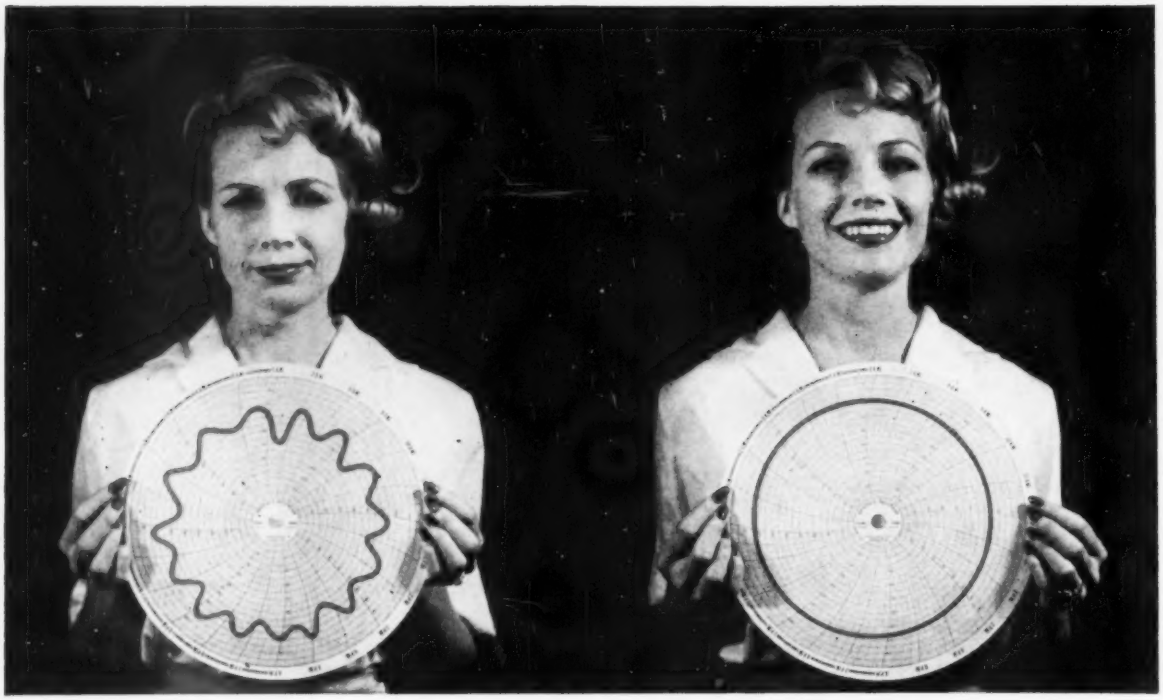
Oronite produces and markets a complete line of dependable gas odorant products. Why not talk over your requirements with the Oronite man. Just phone or write the Oronite office nearest you.

ORONITE CHEMICAL COMPANY

A CALIFORNIA CHEMICAL COMPANY SUBSIDIARY

EXECUTIVE OFFICES • 200 Bush Street, San Francisco 20, California
SALES OFFICES • New York, Boston, Wilmington, Chicago, Cincinnati, Cleveland, Houston, Tulsa, Los Angeles, San Francisco, Seattle
Foreign Affiliate: California Chemical International, Inc., San Francisco, Geneva, Panama

5483



which housewife has YOUR furnace?

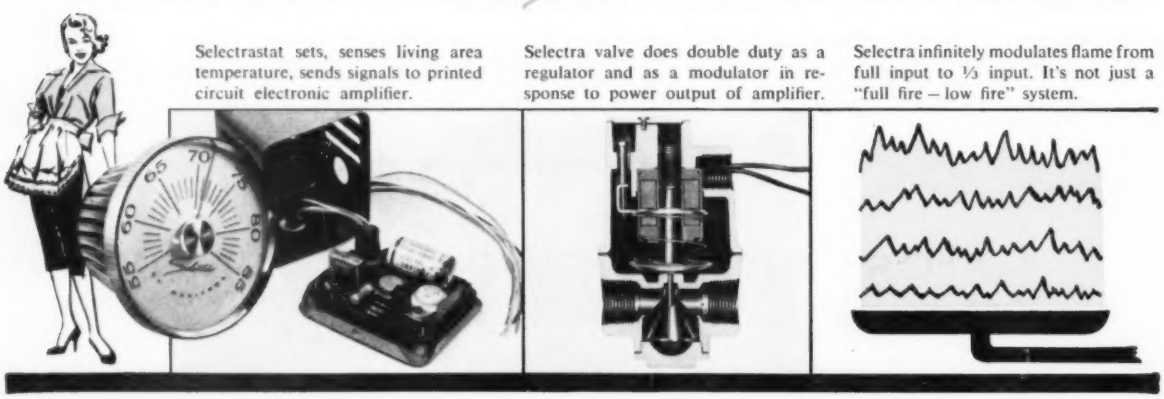
Don't be so hasty with your answer. Most gas fired forced air furnaces are today creating the crazy 24-hour temperature zig-zag you see at the left. The inertia of a full-on, full-off heating system just can't cope with a mild day: the furnace delivers more heat than needed to satisfy heat loss, or none at all. First a hot blast, then cold quiescence.

Now's the time to stop selling furnaces by the pound and make real comfort your big sales feature. The chart at right shows the even temperatures a few householders are already enjoying. Millions are waiting for this comfort and they're going to find it soon in Selectra-equipped furnaces.

Selectra electronic modulation controls the furnace flame in accordance with heat loss in living areas. It assures even, non-cyclic heat, eliminates hot blasts and dead air. If you don't have the story yet, send for eight-page brochure.

MAXITROL *Selectra*

MAXITROL COMPANY • 12200 BEECH ROAD • DETROIT 39, MICHIGAN



Selectrastat sets, senses living area temperature, sends signals to printed circuit electronic amplifier.

Selectra valve does double duty as a regulator and as a modulator in response to power output of amplifier.

Selectra infinitely modulates flame from full input to ⅓ input. It's not just a "full fire – low fire" system.

Current rate-making concepts

THE United States Supreme Court has announced that utility rate-making is the balancing of consumers and investors interests. It has asserted that a regulatory commission is not bound to use any single formula in rate-making, but that the end result reached rather than the method used is controlling.

In granting a recent gas rate increase, the Illinois Commerce Commission made the "pragmatic adjustments" required in performing its function. There are many significant parts to this major gas rate case. The present fair value rate base was $230 million compared with the depreciated original cost of the utility's property of $162 million. The commission found that a 5.9 per cent return was reasonable on the fair value rate base. From annual operating revenues of $117 million, the commission deducted expenses, annual depreciation and taxes to allow net revenue of $13,570,000 for servicing the company's bonds and stock. That amount of net revenue produces more than an 8 per cent return on the depreciated original cost of the gas company's property used in rendering service. This case demonstrates the importance of rate base and the allowed rate of return. Small variations in the adopted percentage return reflect and are equivalent to large variations in the rate base. This case is a good example of current rate-making and the exercise of expertise.

• Rate base

The Illinois Supreme Court has directed the commission under the Public Utilities Act, to base utility rates on the present fair value of the utility property. To ascertain the fair value the commission is required to consider current economic conditions, price levels, reproduction cost, original cost of construction, and the probable earning capacity of the property under the rates fixed. The commission determined the depreciated original cost to be $162 million after deducting the $23 million depreciation reserve from utility plant cost.

Competent witnesses presented evidence on reproduction cost and trended original cost of utility property. The commission adopted $451 million as the cost to reproduce the property new. The trended original cost made by a commission witness totaled $485 million, but the commission considered it as a confirmation of the reproduction cost estimate.

It is necessary to deduct accrued depreciation in determining the utility rate base, and Illinois uses what is called "observed depreciation" as the measure. There was evidence by a commission witness that the utility plant was in 75 per cent condition, and the Peoples Gas witness testified to 83 per cent condition. The commission weighed the evidence and stated:

"The principal difference between North and Luick, relative to the per cent condition each witness determined, pertained to the oil gas production plants, storage facilities, and mains. The witnesses arrived at the observed depreciation for all practical purposes in a slightly different manner. For example, in connection with one of the major items of property, i.e., distribution mains, the record shows that North considered the data available to Luick, and in addition, experience encountered in other metropolitan areas. The record likewise shows that both North and Luick, in arriving at their conclusions concerning observed depreciation, made extensive inspections of the structures and equipment, considering obsolescence due to age as well as physical deterioration.

"It is evident from the qualifications and experience of both Luick and North that their respective studies were reasonably made and that while there was variance in the end results obtained by each, partly due to a difference in method, some differences are to be expected. Observed depreciation is not a subject for exact mathematical determination, but is determined in a large measure in accordance with the judgment of the engineer making the study. Peoples has recognized the difference in the conclusions reached by the two witnesses and in its brief and oral argument before the commission has urged an overall per cent condition of not less than 80 per cent.

"After giving due consideration to the evidence presented by North and Luick, we are of the opinion that the composite per cent condition of Peoples' used and useful depreciable property, as determined in this proceeding as of Dec. 31, 1957, is 78 per cent."

• Working capital

The commission allowed $11 million for working capital, and rejected a claim that tax accruals should be used for working capital.

The sensible analysis by the commission is that:

• Commission analysis

"Louis M. Kessler, a certified public accountant who testified for the city of Chicago, suggested that Peoples' working capital requirements should be determined on an accounting basis. For this purpose, he used the accounting definition of working capital; namely, the excess of current assets over current liabilities, sometimes called net working capital. Referring to Peoples' balance sheet, he found that current liabilities exceeded current assets and, therefore, contended that Peoples was entitled to no allowance for working capital.

"The accounting concept of working capital as used by Kessler has a different meaning and purpose than the rate-making concept of that term. In other words, he has assumed that current liabilities such as tax accruals and customers' deposits, which must be kept available to meet such obligations as they become due, should be utilized to meet working capital requirements. With respect to tax accruals we do not believe it is a sound policy to insist that management invest amounts set aside for federal, state, municipal, and other taxes in natural gas in storage, oil, propane, and other materials and supplies. As to customers' deposits, there appears to be such a seasonal fluctuation in the amount of monies advanced by customers that such a source of working capital cannot be entirely relied upon.

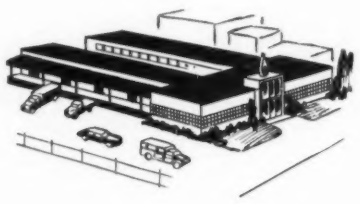
"Commission witness Bird also testified with respect to working capital requirements. He verified the amounts included by Pilgrim for materials and supplies and natural gas in underground storage, and further stated that the minimum cash balances which Peoples is required to maintain with the principal banks with which it does business is in excess of the minimum bank balances set forth in that portion of Pilgrim's study of working capital requirements."

• Fair rate of return and deferred taxes

The city of Chicago witness recommended a rate of return within the range of 5.85 per cent to 6 per cent. The gas company expert testified that a fair return was not less than 7.25 per cent. The commission reasoned thus:

"In our determination of a fair rate of return we have considered all the factors which influence the cost of debt capital and equity capital. We have reviewed the past financing program of Peoples, which financing was in part for the benefit of, and occasioned by, People's subsidiary interests, and have given consideration to the mode of financing of estimated capital additions. We have considered both historical cost and current cost to arrive at a proper allowance for cost of long-term debt capital. We have tested cost of equity capital by the various means used by the witnesses in this proceeding, such as dividends, dividend yields, earnings-net proceeds, and earnings-price ratios." . . .

"As of Dec. 31, 1957, the reserve for 'deferred federal income tax, accelerated depreciation,' amounted to $905,321 and if Peoples continues to expand, the reserve for such deferred federal income taxes will increase. We have previously held in other cases that the sum of money so accrued become interest free funds for plant expansion; and, consequently, the rate-payers benefit to the extent that the utility does not have to obtain that sum of money at a cost to it. We are of the opinion that the accruals of deferred income taxes should be considered concurrently with the evaluation of a fair rate of return. This we have done.



"In our final determination of a fair rate of return we also considered current economic conditions which are reflected in our judgment of a proper rate of return to Peoples as related to the rate of return of other enterprises having corresponding risk, yet mindful that the rate of return must be adequate to maintain Peoples' credit and financial integrity for the continuing attraction of capital.

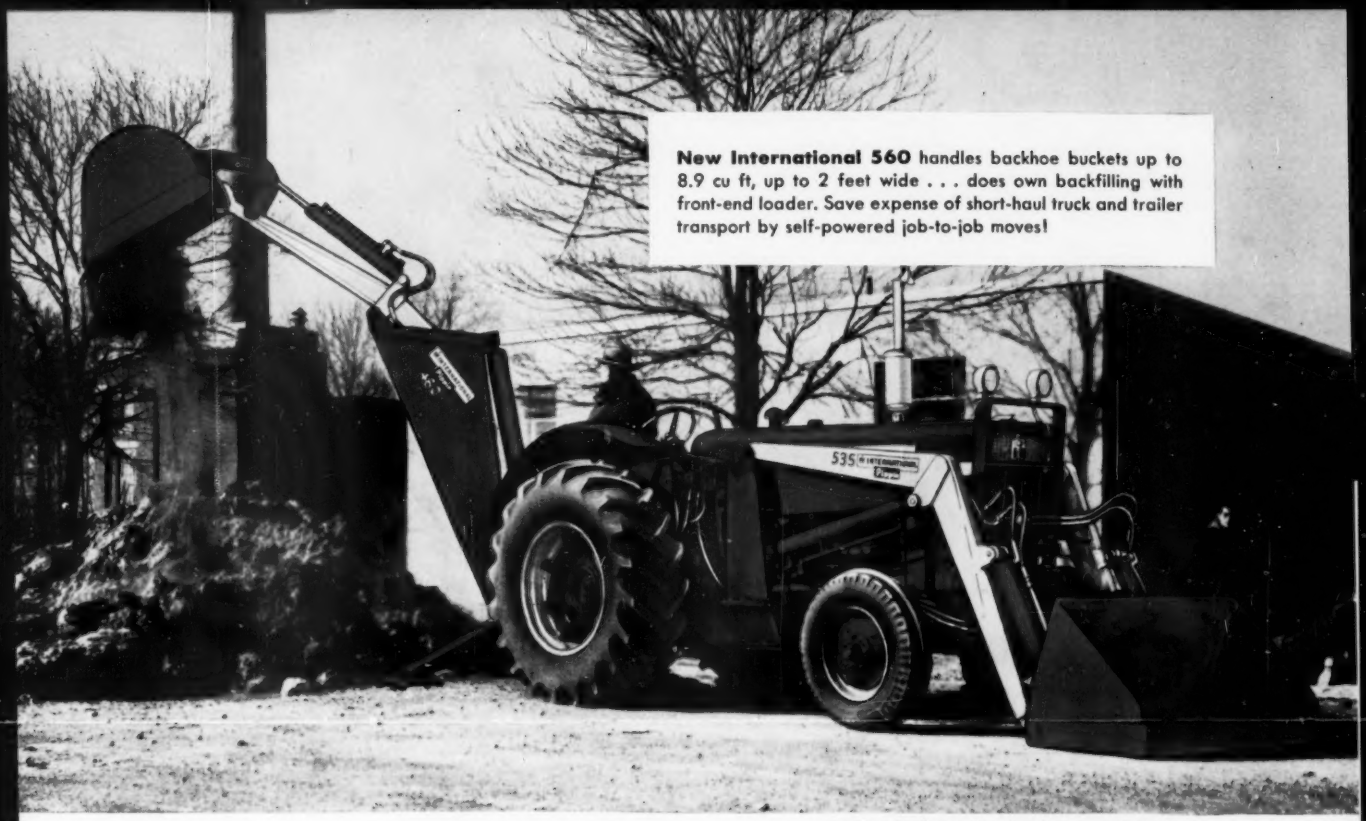
"We conclude from the entire record in this case that a fair rate of return on the fair value of the Peoples' used and useful gas distribution property is 5.9 per cent."

• Deferred tax reserve

The Illinois commission gave cogent reasons for not deducting the property financed by Federal income tax deferrals from the rate base. The commission stated:

"The city urges that the reserve for deferred taxes resulting from the Peoples use of accelerated depreciation for income tax purposes should be deducted from the rate base. Ratepayers, both present and future, receive a benefit from the tax reserve to the extent that Peoples does not have to obtain such money at a cost to it. The purpose of the congressional enactment providing for accelerated depreciation, Sec. 167 of the Internal Revenue Code of 1954, would be defeated if this commission were to deny utilities the same tax treatment which is allowed other concerns under that section. To deny utilities the right to earn a return on plant paid for out of funds made available by deferring payment of income taxes would be to work a discrimination not intended by Congress and would defeat its purpose which is to provide an incentive for plant expansion and improvement. No adjustment will, therefore, be made for this item in either operating expenses or rate base."

Here is current rate-making in action by one of the nation's leading regulatory commissions. The Illinois commission has foresight. ■



New International 560 handles backhoe buckets up to 8.9 cu ft, up to 2 feet wide . . . does own backfilling with front-end loader. Save expense of short-haul truck and trailer transport by self-powered job-to-job moves!

Backhoe-loader combination: International Pippin

⅓ cu yd bite . . . on rubber!

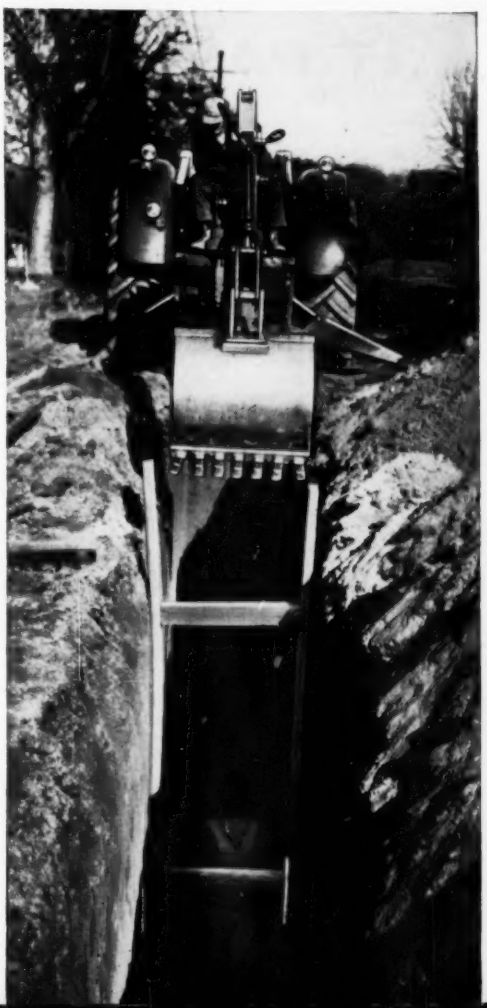
New International® 560 tractor

Put more than 3 tons of built-in brawn plus tremendous hydraulic down-pressure behind a ⅓-yard bucket . . . the 72.5 hp* International 560 delivers *irresistible* force for digging more than 13 feet deep on the toughest trenching assignments!

You match . . . even outdig . . . single-purpose machines because of job-to-job mobility to handle small-yardage jobs that higher-priced, specialized rigs can't afford to touch. You get double-duty from the husky gasoline, diesel or LP Gas power plant, too, with the big capacity front end loader.

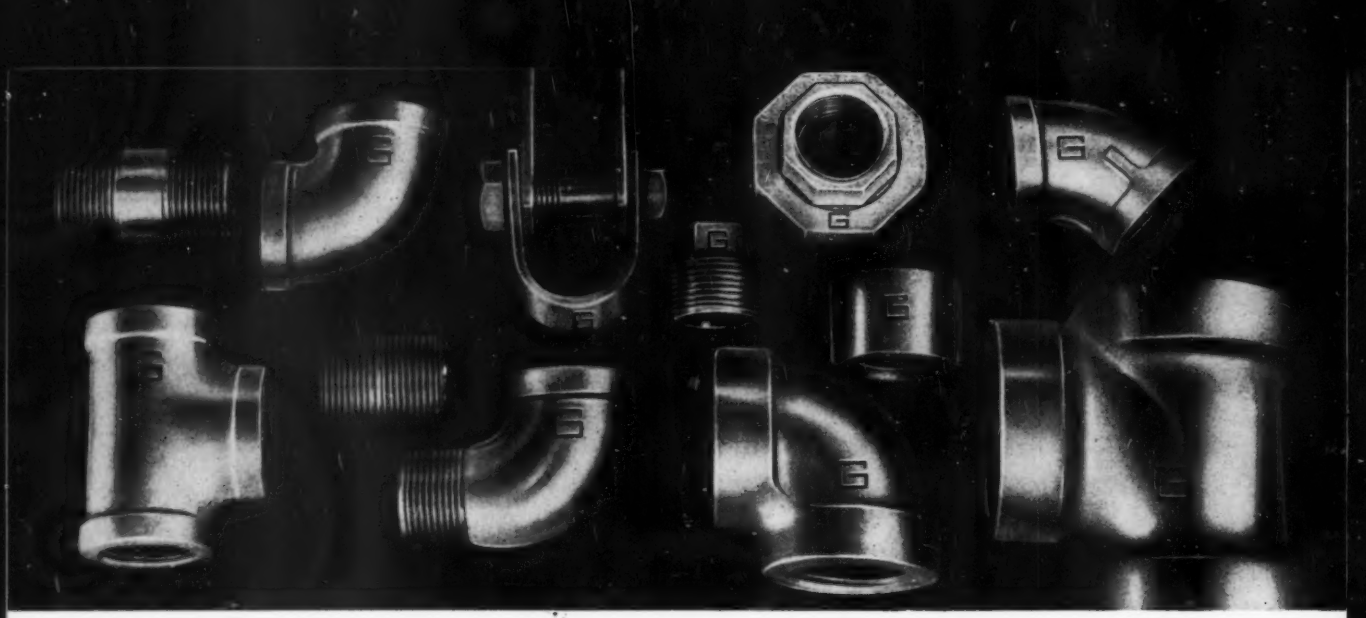
Ask your IH dealer to demonstrate the big, burly 560 . . . or others in the complete International wheel tractor line, 13.4 to 90 hp*. For free catalog, or name of your IH Dealer, write International Harvester Co., Dept. G-7, P. O. Box 7333, Chicago 80, Ill.

**Maximum flywheel hp*



See your **INTERNATIONAL HARVESTER** dealer

International Harvester Products *pay for themselves in use* —Farm Tractors and Equipment . . . Twine . . . Commercial Wheel Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Illinois



STANDARDIZE

with GRABLER FITTINGS

...IT PAYS!

There is a Grabler Square "Gee" Pipe Fitting for practically every known plumbing or heating job requirement. From solder-joint fittings to malleable, cast iron, drainage, nipples, and hangers, you will find what you need from Grabler's *complete* line of pipe fittings.

Important to you is the fact that Grabler fittings come to you package-protected – makes them easy to handle and identify. Dependable distribution means your wholesaler can fill your order fast and complete. *Standardize* your next pipe fitting order – make them Grabler Square "Gee" Fittings.

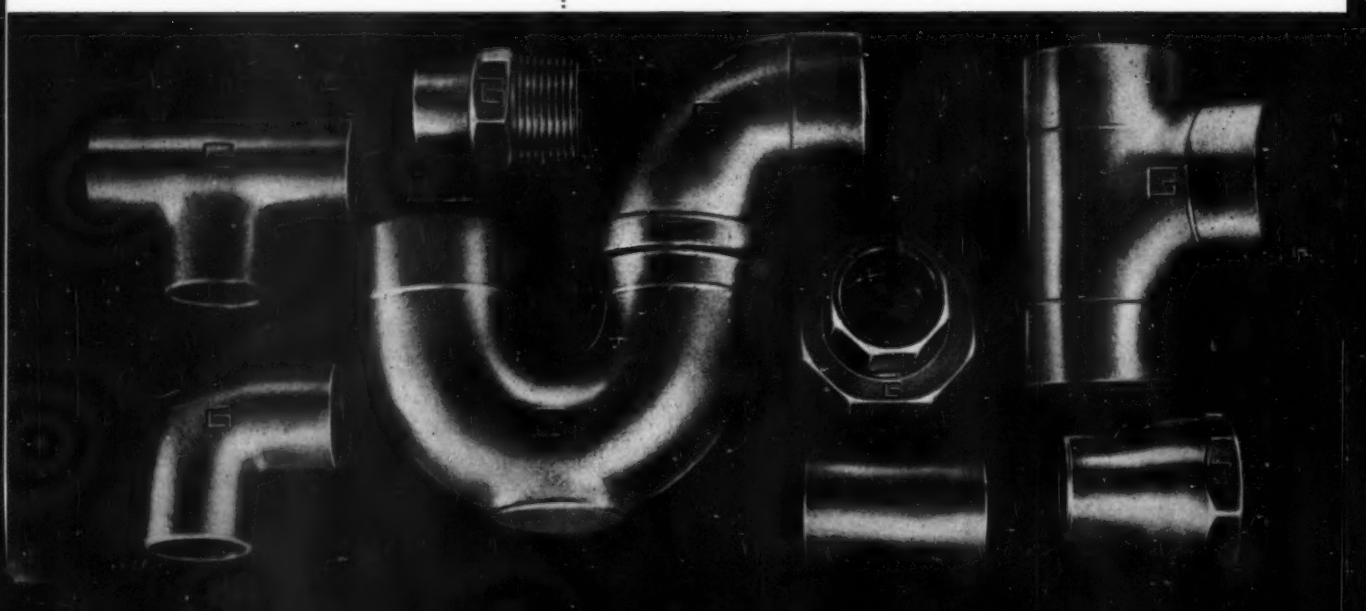
Warehouses Providing Dependable Service to Wholesalers

New York • Philadelphia • New Orleans
Boston • Atlanta • Pittsburgh • Cincinnati
Dallas • Chicago • St. Louis • Detroit • Denver
Minneapolis • San Francisco • Los Angeles

GRABLER SQUARE "GEE" PIPE FITTINGS

ORDER A SUPPLY FROM YOUR WHOLESALER TODAY

The GRABLER Manufacturing Co. • 6565 Broadway • Cleveland 5, Ohio



TECHNICAL TRENDS

By GUY CORFIELD

Btu meters show heat pick-up or loss

Three interesting instruments have recently appeared in new products literature. They are designed to measure and integrate heat gain or loss in a liquid flowing through a heating or cooling system.

Hays Corp., Michigan City, Ind., has developed an integrating recorder, said to be applicable to heat exchangers, cooling towers, refrigerating systems, etc. Platinum resistance thermometers are installed in the inlet and outlet piping of the system. These thermometers are two legs of a resistance bridge in the recorder and produce a differential temperature impulse as the recorder balances itself. Liquid rate in the piping is also measured by a flow transmitter which feeds a quantity impulse into the recorder. These two signals are integrated in the recorder to show the heat, per unit of time, gained or lost by the flowing liquid.

Another instrument, called the Pollux heat pump Btu meter, is distributed in the U. S. by the Air Conditioning Equipment Corp., New York. It is a mechanical device consisting of a liquid meter, two temperature sensing bulbs for installation in the liquid supply and return lines, and an integrator. It has been developed for measuring the heating or cooling effect supplied by hot or chilled water. Its usefulness is suggested for exact analysis of services rendered by a central heating or cooling plant to each of several customers or tenants. It shows heating rate on one dial and cooling on another, depending on which function is taking place, and cumulative Btu's on corresponding digital counters. It also gives temperature indication.

A third Btu meter for water systems, Model 200, is announced by the American Meter Co., Mechanical Components Dept., Garland, Texas. It is also mechanical, and is advocated for measuring heating or refrigeration effect supplied by central air conditioning systems using hot or chilled water. It multiplies temperature change of the water (in and out of the system) by flow, and two counters register the heat transferred and the water flow. Differential temperature is also indicated.

Nuclear process heat

Most of the emphasis and publicity on nuclear fuel has been placed on the production of electric power from large nuclear heated steam-electric generating plants. There has been, however, concurrent and persistent attention given to the possibility of nuclear process heat for general industrial and central space heating purposes through low pressure steam.

Process steam from combustion of fossil fuels (coal, oil and natural gas) costs between about 90 cents and 50 cents per 1000 lb or per million Btu, depending on the local price of the fuel plus the factors of first cost, life of equipment, etc.

Those who view nuclear process heat most favorably have made surveys and calculations which indicate that in areas of high cost fossil fuel the nuclear route is now competitive, if the Atomic Energy Commission will assist in pioneering the venture, as they now are with large electric power plants, by subsidizing the high first cost by absorbing capital investment over $1.5 million. With this subsidy it is felt that nuclear process steam could be produced for from 75 to 65 cents per million Btu for plant sizes of 150,000 to 300,000 lb of steam per hour. They think the present market for such plants is 50 to 100 per year, and as experience is gained cost of steam would become cheaper and continued government subsidy would not be necessary.

Balanced against this optimistic viewpoint are a number of factors which are causing both AEC and private industry to hesitate. Capital cost of a nuclear process heat plant is estimated to be at least double that of an equivalent plant fired by fossil fuel. Nuclear plants, as they are now visualized, would have to be amortized over a 10-year period, whereas conventional plants have a life of 20 years or more. Also nuclear process heat could be produced practically and economically only at rated and relatively constant load —not for auxiliary purposes at low or variable output.

How cold is the wind?

How much colder does one feel when there is a wind, as compared to exposure to still air, the actual air temperature being the same in both instances?

The Army was interested in this question from the standpoint of protecting troops from "cold injury," and their Medical Research Laboratory at Fort Knox, Ky., has come up with a Wind Chill Table. The table is published in the March 1959 issue of Air Conditioning, Heating and Ventilating (page 88). It covers wind velocities up to 45 mph and temperatures from 90 deg. F downward. The figures are quite surprising. For instance, if the expected temperature is 34 deg. F and wind velocity 20 mph, the feeling on exposed flesh is equal to that produced by 38 deg. F below zero with no wind. To pick an air conditioning situation, if the air temperature is 76 deg. F and its velocity 5 mph, a person in this air stream would receive the same sensation as being in quiet air at 60 deg. F.

SPOTTY HEAT
The old fashioned wood or coal-burning stove generated plenty of heat but most of it was wasted . . . went straight up the flue. To keep warm, you kept close.

BASIC . . . but better than ever today

WARMTH WHEREVER YOU ARE . . . Thanks to modern gas distribution gas heat is evenly distributed, instantly available and responsive . . . comfort at the touch of a thermostat.

Two of the many features of cast iron pipe that make it ideal for expanding gas systems are its established quality and dependability.
To provide both, U. S. Pipe controls every production step. From mining of raw materials to finished product, all U. S. Pipe is checked and rechecked for quality. This added care and precision in manufacture is one more reason for U. S. Pipe performance and dependability in service. Where it counts!

SERVICE IS BUILT INTO CAST IRON

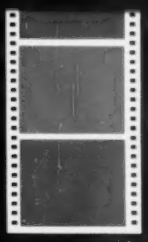
- Standardized mechanical joints are bottle-tight for usual gas distribution pressures . . . and for all types of gas.
- Centrifugally cast pipe is tough, strong and uniform.
- Joint design allows for deflection during and after installation.
- Service connections are easily made.
- Long life a matter of record.
- No shortages. Cast Iron pipe is immediately available.

U.S. cast iron PIPE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

GEM Sponsor

A WHOLLY INTEGRATED PRODUCER
FROM MINES AND BLAST FURNACES TO FINISHED PIPE.



NEW, FIRST-OF-ITS-KIND PROGRAM TO HELP YOU SELL MORE GAS AIR CONDITIONING

Specially-written motion picture and colorful booklet help pre-sell the lady of the house as never before!

JANE DARWELL, star of stage and screen, joins your selling force.

EVERY WOMAN

NOW AVAILABLE TO YOU...

"Mother Knows Best"

18-MINUTE COLOR FILM STARRING

ACADEMY AWARD WINNER, Jane Darwell

SPONSORED BY HONEYWELL IN COOPERATION

WITH THE AMERICAN GAS ASSOCIATION.

WHO SEES THIS COLOR MOVIE WILL SERIOUSLY CONSIDER AIR CONDITIONING HER HOME WITH GAS!

This sparkling new movie is designed for use by everyone in the gas air conditioning industry. It's a situation comedy offering pleasant entertainment to America's millions of housewives while educating them to the benefits of gas air conditioning.
The story takes a humorous approach to typical family reactions to hot weather, while getting viewers enamored with air conditioning. Jane Darwell plays a crotchety mother-in-law who surprises everyone. It's a movie that every person who is working to promote air conditioning will want the people in his community to see.

HOW TO MAKE THE BEST USE OF THIS MOVIE

* For homemaker gatherings, cooking schools, civic and fraternal meetings—you'll find it a real program highlight.
* For your sales meetings—you can use it as a stimulating change of pace and an aid to building sales enthusiasm.
* For special showings to special groups of prospects or customers—it's an excellent build-up to a product presentation.

AND HERE'S ADDED EMPHASIS FOR YOUR PROGRAM

"Milady's Climate"

A 12-page booklet talking to housewives about their everyday activities. It tells how gas air conditioning can help families to be healthier and get more enjoyment out of everyday living.

This booklet is a story for women, written for Honeywell and the American Gas Association by Margaret Spader, nationally-known Home Economics Editor and Consultant. This respected woman writer helps readers prove to themselves that gas air conditioning is a sound investment in the home.
The conclusion stresses gas air conditioning and urges buyers to take immediate steps to enjoy its benefits.

HOW TO MAKE THE BEST USE OF THIS BOOKLET

* *For handout to homemakers—it's a natural follow-up to present or to mail to audiences after showings of the "Mother Knows Best" movie.*
* *For lead-getting advertising—you can use it as an appealing offer of information to attract prospects.*
* *For salesmen's use—you'll find it an effective talking piece and an excellent sales aid to leave with prospective buyers.*

next page tells how you can get copies of the film and the booklet for your own sales use ▷▷▷

HERE'S HOW YOU CAN GET COPIES OF THE FILM AND THE BOOKLET

Honeywell has absorbed all basic film and booklet production costs as a service to the industry. In addition, Honeywell has cooperated with the American Gas Association to include in both film and booklet a special section which stresses the advantages of gas air conditioning.

IF YOU ARE A UTILITY, you are urged to purchase copies of both the film and booklet for use in your own special markets. Use them for showings at cooking schools and homemaker meetings. Also, offer them to your contractors for use in your area. Copies of the special gas version of the film are available at reproduction cost of $125 for the first print and $100 for each additional print. Satisfaction is assured with a 10-day money-back guarantee.

Copies of the special gas version of the booklet are available at 8¢ each in any quantity you wish. Contact your nearest Honeywell office to place your order for either film or booklets; or place your order directly with Minneapolis-Honeywell, Dept. MCG, Minneapolis 8, Minnesota. Be sure to ask for the gas version.

IF YOU ARE AN AIR CONDITIONING CONTRACTOR, you can purchase copies of the film, as described above. Or you can ask to borrow the film for your showings from your local gas utility or through the American Gas Association field representative serving your area.

Booklets may be ordered from your local gas utility or the American Gas Association; or they may be purchased directly from Honeywell at the price quoted above. Enclose check or money order. Be sure to ask for the gas version.

BE READY TO MAKE THE MOST OF THESE POWERFUL SALES BOOSTERS

place your order today!

THIS PROGRAM JOINTLY SPONSORED BY:

Honeywell

H HONEYWELL First in Control

American Gas Association

25-6106 Printed in U.S.A.

WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau

Trans-Canada refiles for export permit

THE northern end of the giant Midwestern-Tennessee Gas Transmission Co. project may take some time to follow the southern end into the approval stage.

In a little-noticed action, Trans-Canada Pipelines, Ltd., which would supply the northern end of the Midwestern project, has applied for Canadian permission to export gas to this country.

In answer to a question from a member of the Canadian House of Commons, Canadian Minister of Trade and Commerce, Gordon Churchill, confirmed that an export application had been filed by Trans-Canada. The Canadian line, according to the minister, filed the export application April 29.

The application is for licenses to export natural gas at two points on the Canadian border. Trans-Canada proposed to export a firm supply not exceeding 200 Mcf a day to Midwestern at the border near Emerson, Manitoba. This is the gas needed to fill the northern end of the original Midwestern-TGT proposal.

In addition, Trans-Canada has asked for an export license to export on an interruptible basis to Tennessee Gas near Niagara Falls at the option of the Canadian firm when it has gas in excess of its eastern Canadian requirements.

Spokesmen for the nine major firms involved in the original Midwestern case now believe that the northern line will eventually be approved, using imported gas, but that the two will not be connected as originally proposed for some time, if ever.

The Federal Power Commission after rejecting all bids for serving the Chicago and other upper Midwest areas of the country approved a divorce of the northern and southern sections of the Midwestern proposal.

In approving recently the essence of the southern system, the FPC did not rule out eventual interconnection with the northern part of the project. But it appears unlikely that all the opposition on both sides of the border will be worked out for many years.

In the southern section, the FPC approved a new line from Portland, Tenn., to Joliet, Ill., to connect with the Chicago District Pipeline Co. This approval, along with permitted expansion of Tennessee Gas to supply the line, means badly needed additional supplies of gas to serve the Chicago area.

The original 7 per cent rate of return proposed by Midwestern for the southern section was called "too high" by the FPC, and cut to 6¼ per cent. Midwestern was also put under restrictions on paying common stock dividends until some debt repayments of the $50 million project are made. It upheld a proposed 22-cent-per-thousand commodity rate for the project, but required that new rates be filed after the first year of operation.

Midwestern filed its amended application with the FPC for the northern section of the continent-spanning line about the same time that Trans-Canada filed for its export license.

In its revised form, the northern section calls for a $52.2 million, 504-mile line from a connection with Trans-Canada at Emerson to a point near Marshfield, in central Wisconsin. There, the line will tie in with Michigan Wisconsin Pipe Line Co., which will sell to a host of areas in Michigan and Wisconsin.

The export application filed by Trans-Canada is the first official export bid for the line. In the original proposal, Midwestern and Tennessee filed a plan for a connected line and secured from the party then in control of the Canadian government a firm promise of an export license when the time came. However, the government changed, the promise was thus worthless, and a special commission appointed by the new government in an interim report in effect urged exports wait for creation of a new central fuel regulatory body.

Against the background of this Canadian off-and-on export policy, Trans-Canada's bid and thus Midwestern's northern project faces a hard road to winning the final necessary go-ahead.

TRANSWESTERN Pipeline Company's bid to challenge El Paso's domination of the California natural gas market is running into the predicted heavy going.

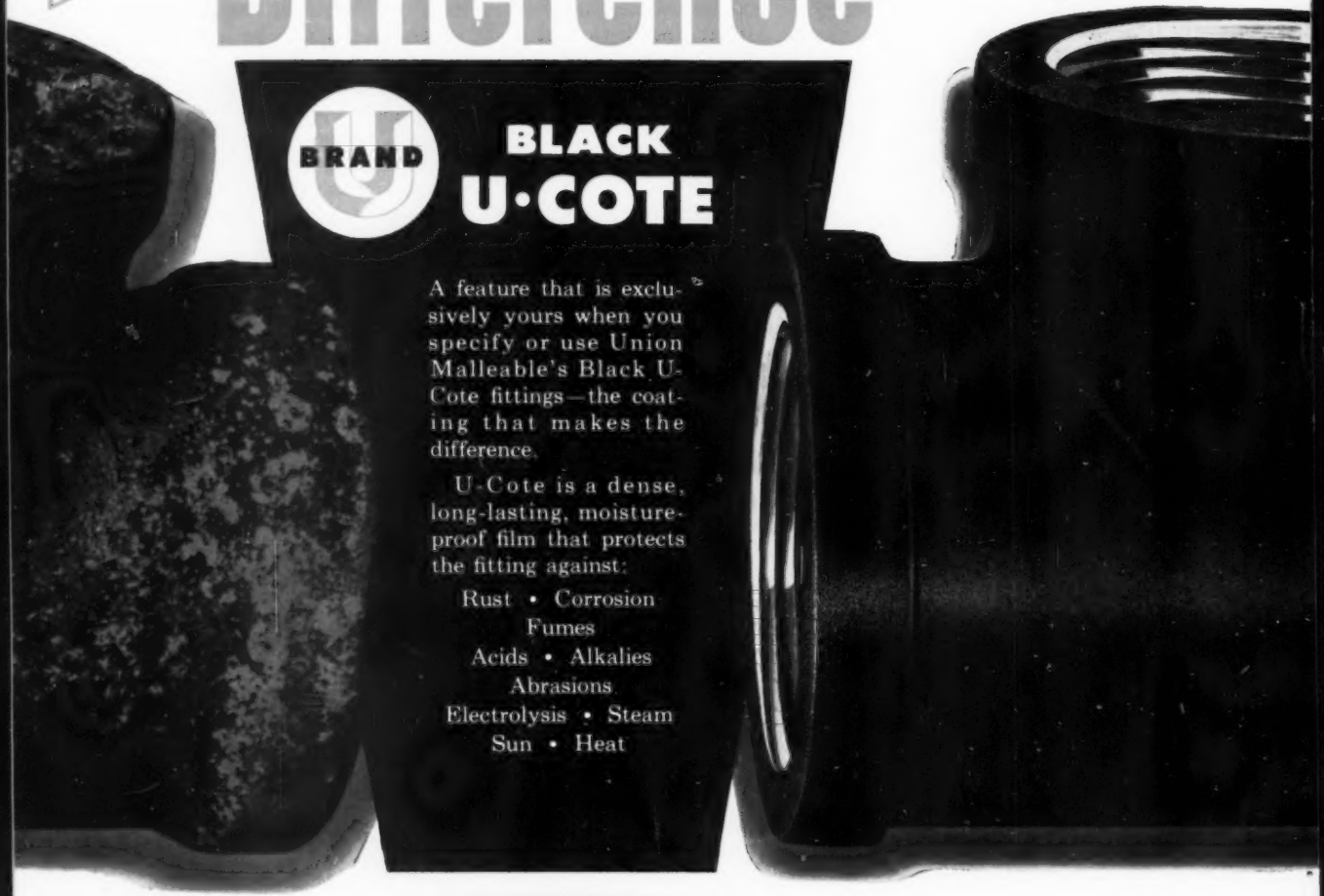
Transwestern is seeking FPC approval for $190 million, 1809-mile line from Texas-Oklahoma producing areas (via Roswell, N. M.) to the Arizona-California border to sell 300 MMcf a day to Pacific Lighting Gas Supply Corp. for resale through associates in southern California.

Hearings on the case finished in late May. Final briefs and arguments were submitted to the hearing examiner May 25, and the examiner was expected to issue his findings sometime in late June or early July.

Earlier, El Paso had sought to have a ruling from the commission on whether the southern California market is big enough to ab-

Continued on page 156

There is a Difference


U BRAND
BLACK
U·COTE
A feature that is exclusively yours when you specify or use Union Malleable's Black U-Cote fittings—the coating that makes the difference.
U-Cote is a dense, long-lasting, moisture-proof film that protects the fitting against:
Rust • Corrosion
Fumes
Acids • Alkalies
Abrasions
Electrolysis • Steam
Sun • Heat

SHIPPING DEPOTS
For Fast Service:
Albany
Ashland
Atlanta
Chicago
Dallas
Denver
Portland
Los Angeles

The Union Malleable Manufacturing Company
Ashland, Ohio • Vernon, Calif.

U-Brand for ALL your fitting needs:
Galvanized and Black U-Cote Fittings; Unions; Plugs; Cast Iron Drainage and Screwed Fittings; Steel Nipples and Couplings; Nylon, Brass, Steel and the exclusive Poly-Plus Blue Insert Fittings for flexible plastic pipe applications.

By MARSHALL E. PARKER

The remote electrode

THE controversy, or rather the confusion, over the use of the "remote" electrode in determining the criterion for cathodic protection, continues to rage. From time to time proof that this is the valid criterion appear; all are fallacious. These proofs tend to fall into three categories: (1) it is less expensive to protect a line using a remote electrode for the criterion; (2) the potentials with respect to a remote electrode are consistent with potential differences along the line, i. e., IR drops; and (3) current requirements determined by the use of a remote electrode are consistent with those determined by other criteria. Some papers present all three proofs in one charge, like a shotgun.

The first type of proof, which asserts that the remote electrode position is valid because cathodic protection determined by this criterion is less expensive than that determined by the use of a near electrode, is obviously fallacious when used alone. Yet this one is presented time after time. This is the same kind of argument as the one, frequently encountered, which lists certain values as being the current requirements of a given line, when closer examination shows that these values are merely the amount of current the line happens to be getting, with no reference to whether or not it is actually being protected. It is much cheaper to illuminate a house with 25-watt globes than it is with 100-watt globes, if you accept as illumination the filling of all the sockets in the house, without regard to the amount of light produced.

The second argument, to the effect that the results obtained with respect to a remote electrode are usually consistent with the measurements of IR drops along the structure, is merely an irrelevant argument. Two remote positions of the electrode are likely to show no difference in potential (if there is a difference, then one or both lies in some anode or cathode field, and is thus ineligible); hence taking structure to soil potentials to two such positions is like taking them to a single location. Naturally, the two potentials taken to a single location—be it near or far—will agree with the difference in potential along the structure. It is for this reason that all of the attenuation theory is based on the remote electrode; similarly, the methods for the measurement of coating leakage conductance all use a remote electrode, and all measure, or attempt to measure, conductance to remote earth.

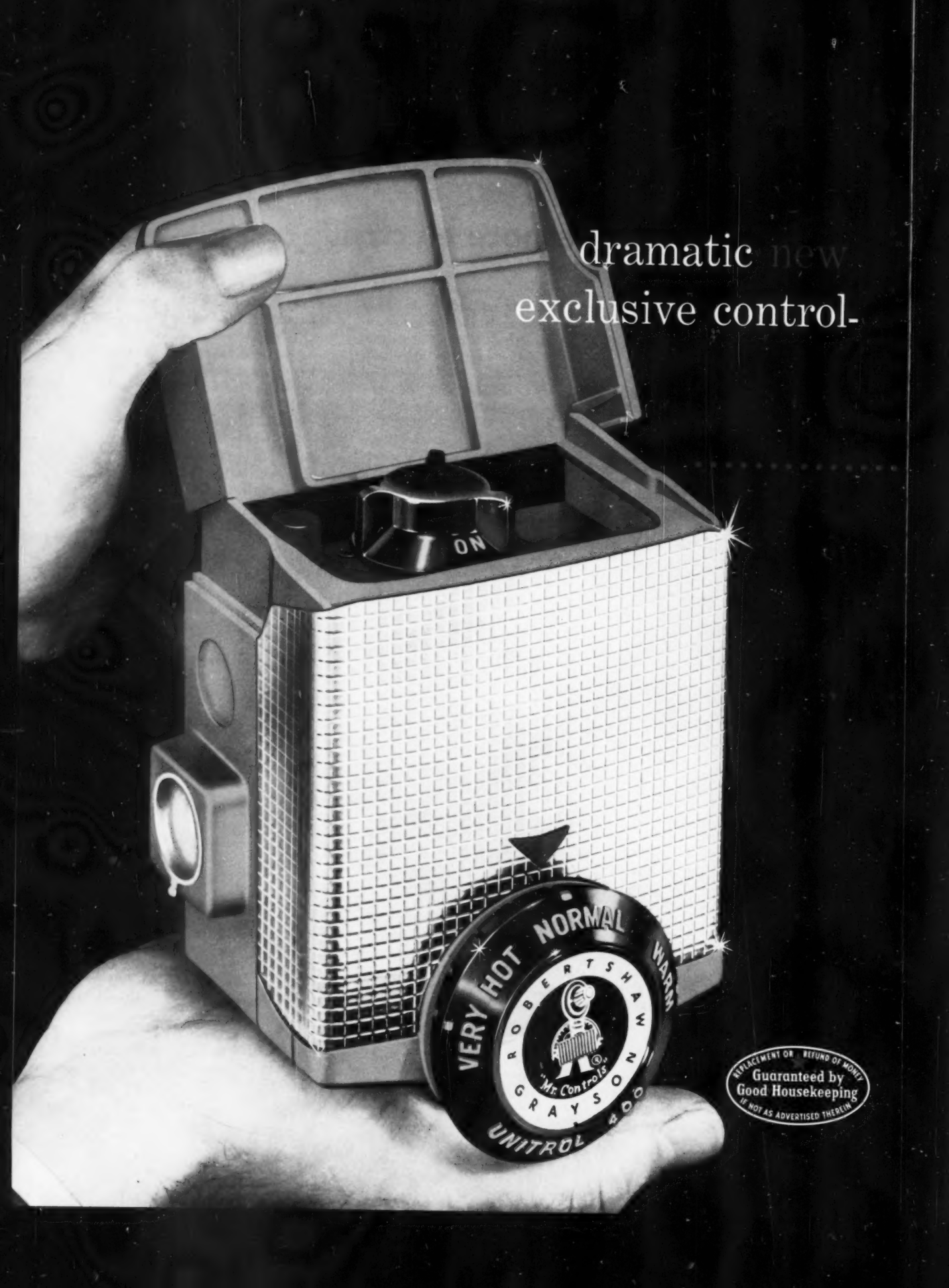
But none of this has anything at all to do with cathodic protection; these studies are useful in determining the flow and field of the currents we use for cathodic protection, but the act of protection itself is an electrochemical phenomenon, taking place at or very near the metal/electrolyte interface. The current which brings this about may travel a very long journey, and may be detected and measured in its passage, at great distances from the surface in question; but the cathodic protection itself is at the surface.

This does not mean that cathodic protection does not produce any effects measurable at remote distances. Actually, it produces two such effects. When the cathodic protection current is flowing, there exists an IR drop in the soil between the structure and remote earth; this is spurious, insofar as a criterion for protection is concerned; it depends largely upon the resistivity of the soil. But there is another effect; when the surface is protected, changes take place which make of it a different kind of electrode; its potential changes, with respect to *any* reference electrode, placed at *any* location, and hence also with respect to a remote electrode. This change is truly significant, and is the one used in the various methods which involve locating the break in the potential-log current curve. The fact that this is a valid method for determining protection does *not* mean that the obtaining of any specified potential (such as 0.85 volt, for example) with respect to a remote electrode *with the cathodic protection current on* is a valid criterion; the two things are entirely different.

This is the kind of proof usually adduced by those who approach the problem from the viewpoint of circuit analysis, or of equivalent circuits. The approach from field theory is less likely to lead to this sort of error, because of the constant awareness of the various fields and their confusing effects upon the quantities we are trying to measure.

The third type of proof, by the citation of one or more instances where the remote electrode criterion gives essential agreement with the determination of current requirements by other and accepted means, is more subtle. The fact is that the simple 0.85 volt criterion to a nearby electrode is very conservative; often protection can be achieved with less. It is usually one of these cases, generally involving a large bare structure in a

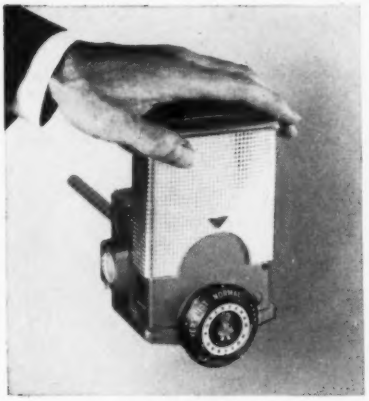
Continued on page 148


dramatic new
exclusive control-
ON
VERY HOT
NORMAL
WARM
ROBERTSHAW
"Mr. Controls"
GRAYSON
UNITROL 400
REPLACEMENT OR REFUND OF MONEY
Guaranteed by
Good Housekeeping
IF NOT AS ADVERTISED THEREIN

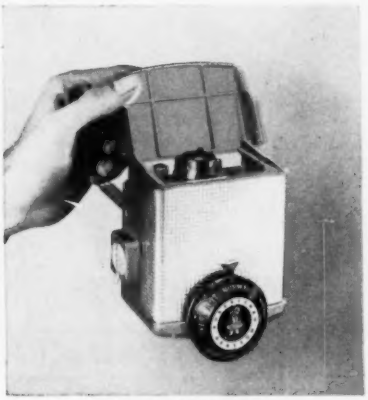
ROBERTSHAW UNITROL 400R provides a new, selling feature you never had before...

.....DEMONSTRATION

DEMONSTRATE the most beautiful control in the world!



DEMONSTRATE the exclusive new slip-top cover!



DEMONSTRATE the exclusive new flip-top lid!

Show customers the Unitrol 400R with the slip-top cover and the flip-top lid... *for greater water heater sales*

Equip your water heater with the control which will help sell it...the new Robertshaw Unitrol 400R! The lid flips up, and the whole cover slips off for easy pilot lighting. Here is a control your sales people can *demonstrate* to customers... here is a control which will enhance your water heater's ability, utility, recovery capability (the Robertshaw Unitrol 400R features a built-in pressure regulator) and reliability!

The Robertshaw Unitrol 400R will help you sell your top line water heaters or raise the sales of lower priced heaters!

FOR MORE INFORMATION CONTACT:

Robertshaw

GRAYSON CONTROLS DIVISION • LONG BEACH, CALIFORNIA

A *NEW* INDUSTRIAL GAS

with *Dyna-Balance*—Built especially for tough commercial and industrial applications

FISHER Type 166

has large capacity and precision performance characteristics

- **A fully balanced inner valve provides absolute tight shutoff at low lockup pressure.**
- **All inner valve parts easily removable through blind flange without removing regulator from the line.**
- **Unusually large capacity throughout its performance range.**
- **Shock resistant! Controlled pressure holds constant even with snap acting solenoid valves opening and closing in downstream system.**

CONSTRUCTION DATA

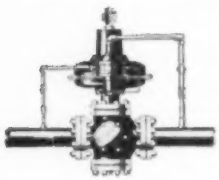
It is available in two constructions—**Type 166-1** has 1" diameter ports and is available with 1½" or 2" screwed and 2" 125-lb. flanged bodies.

Type 166-2 has 1⅞" diameter ports and body size is 2" screwed or 2" 125-lb. flange. The pressure ranges are:

Type 166-1—Inlet up to 125 psi
Outlet 4" W.C. to 10 psi
(7 different springs available)

Type 166-2—Inlet up to 60 psi
Outlet 3" W.C. to 5 psi
(6 different springs available)

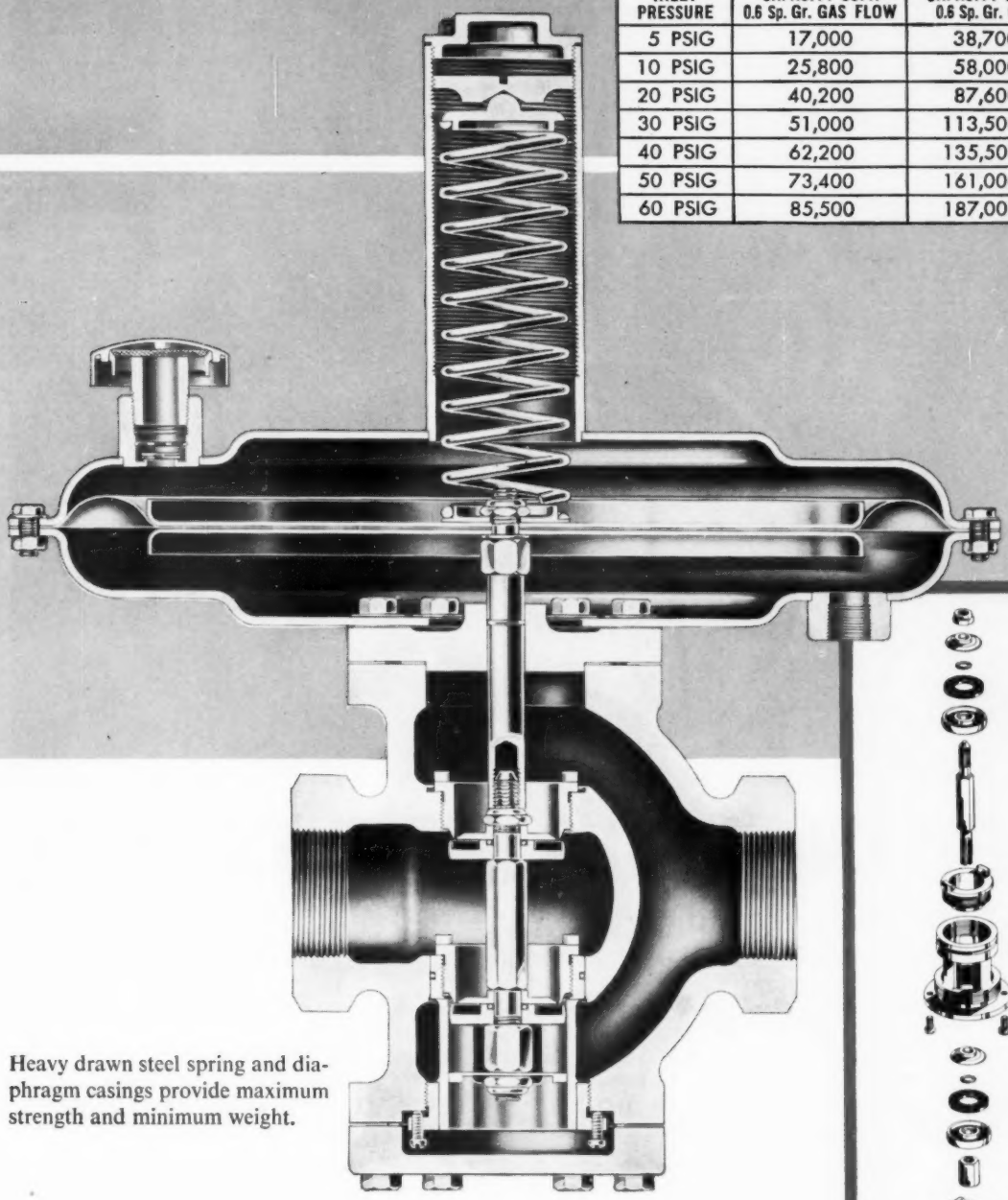
Commercial and industrial installations requiring greater gas volume have long needed a heavy duty regulator such as the new balanced Fisher Type 166. Talk about high capacity—the 166 has it! For example, the Type 166-2 with 1-⅞" ports will pass 38,700 CFH of gas with a 5 psi inlet and a 7" water column outlet. Inner valve incorporates a "Dyna-balance" effect to boost outlet pressure with increasing flow. Send for Fisher Bulletin P-166.

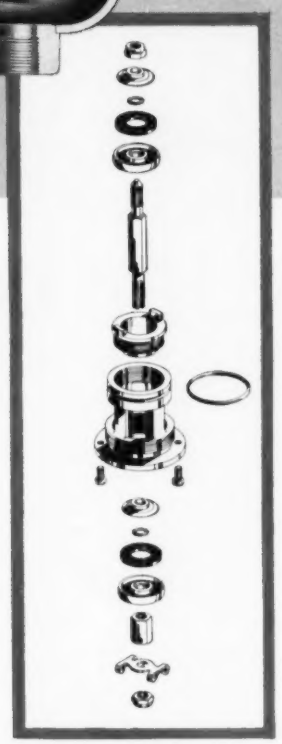


IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

REGULATOR

OUTLET PRESSURE = 7" W.C.		
	TYPE 166-1	TYPE 166-2
INLET PRESSURE	CAPACITY SCFH 0.6 Sp. Gr. GAS FLOW	CAPACITY SCFH 0.6 Sp. Gr. GAS
5 PSIG	17,000	38,700
10 PSIG	25,800	58,000
20 PSIG	40,200	87,600
30 PSIG	51,000	113,500
40 PSIG	62,200	135,500
50 PSIG	73,400	161,000
60 PSIG	85,500	187,000

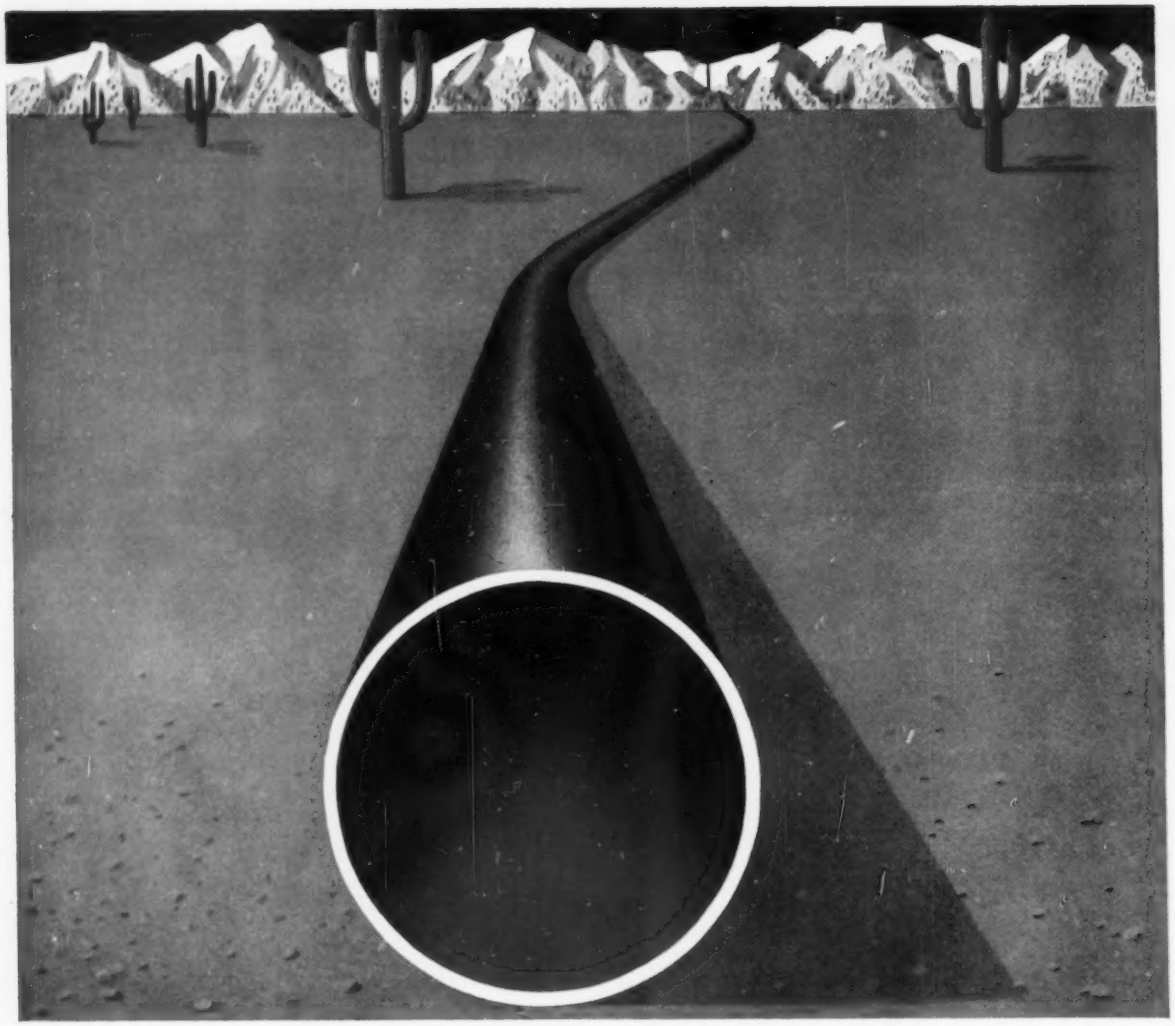




Heavy drawn steel spring and diaphragm casings provide maximum strength and minimum weight.

FISHER® Controls
SINCE 1880

FISHER GOVERNOR COMPANY
Coraopolis, Pa. / Woodstock, Ontario / London, England
Main Office and Plant: MARSHALLTOWN, IOWA



ALLIED CHEMICAL'S HOTLINE ENAMEL

defies 180°F. heat without sliding and −10°F. cold without cracking

Allied Chemical Hotline Enamel's resistance to both high and low temperatures, as well as its greater durability, compared to asphalt base and other coatings, has been proved by laboratory tests, and on-the-job performance for leading public utility companies. Allied Chemical Hotline Enamel is derived from coal-tar pitch, thus possessing inherent protective properties against the damaging effects of water, soil chemicals and electrical currents.

Improves protection under these specific conditions:

1. On pipe-type cables or "oil-o-static lines" which are subject to internal electrical heat from high-voltage surges.

2. Hot gas pipelines, on discharge side of compressor stations where line is above 120°F.

3. Warm, swampy areas or other places where excessive soil stress is encountered.

4. Areas where backfill and trenches are rough, rocky or contain objects which normally penetrate softer coatings.

5. Pipelines (such as heated fuel lines) where temperatures are constantly high most of the time, but do not exceed 180°F. or 200°F. for short term exposure.

A staff of field service experts are at your call to offer you technical assistance that can save you maintenance time and costs. **LAST WORD IN CORROSION PROTECTION.**

PLASTICS AND COAL CHEMICALS DIVISION
40 Rector Street, New York 6, N. Y.

Allied Chemical

7 TIMES LIGHTER

HANDLEY-BROWN CURB BOXES

Models with or without stationary rods.

PAT. APPLIED FOR

In Gas Service Equipment, H-B *engineering* makes the big difference...

NON-CORRODING TOUGH and EASY-TO-FIND

Handley-Brown curb boxes are 7 times lighter than cast iron. Fabricated from a resin-rubber compound*, they are non-corroding. Built to last a lifetime. The easy-telescoping section prevents damage to service stop and piping.

They're easier to find, too. Permanent, built-in magnets with aluminum plates make these boxes easy to locate with either magnetic or electronic finders. Another plus feature . . . the high arch design of the base gives good clearance for curb stops, and allows ample room for foot piece.

Roadway Valve boxes* also available.

FOR COMPLETE INFORMATION MAIL COUPON

*A. B. S. Polymer

End call-backs with attractive H-B outside meter boxes. Available as shown, or for recessed installation. Made of tough resin-rubber compound*.

Service Test Station. Provides a test station for leak surveys. Permanently installed. Makes random probing unnecessary. Made of tough resin-rubber compound*. Main test station also available.

H-B Cathodic Terminal Box. Landscape engineered, and non-corroding*. Leads are attached to the terminal block in the cap for easy testing.

Master Poly-Trol *automatic* gas shut-off valve. Shuts-off gas in event of overpressure, underpressure, excessive high temperature, and flooding. Serves also as a tamper-proof manual shut-off.

HANDLEY-BROWN CO., 2102 Brooklyn Rd., Jackson, Michigan

Gentlemen: ☐ I am interested in the Handley-Brown line of gas service equipment. Please send your complete catalog.

☐ Please have your representative phone for an appointment.

*Name*_____ *Title*_____

*Company Name*_____

*City*_____ *Zone*____ *State*_____

HANDLEY-BROWN CO.

BROOKLYN ROAD · JACKSON, MICHIGAN

"H-B engineering makes the big difference"

REG. U.S. PAT. OFF.

SCOTCHRAP

BRAND

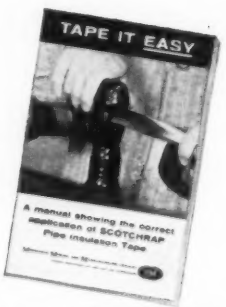
PIPE PROTECTION

Tapes are TOUGHER!

Proved by 200-hour torture test!

Each of the five lengths of pipe shown was covered with a different protective coating—both tapes and mill coatings. They were then fastened in a barrel containing abrasive tumbling chips and continually tumbled for 200 hours. This unretouched photo shows the results: only the "SCOTCHRAP" Pipe Protection Tape, far right, survived intact!

This controlled test was designed to measure the resistances of various coatings to backfilling and soil stresses. It clearly demonstrates the superior abrasion and puncture resistance and excellent bond strength you get *only* with "SCOTCHRAP"—the toughest polyvinyl chloride plastic tape. These properties are so superior that with normal care, no protective overwrap is needed. Add the excellent electric properties, and you have the reasons why we believe "SCOTCHRAP" is the best total coating buy you can make.



SEND FOR FREE MANUAL!
New "Tape it Easy" booklet gives application methods, useful specifications, for "SCOTCHRAP" Pipe Protection Products. Write 3M Co., St. Paul 6, Minn., Dept. EAL-79.

FOR **MAXIMUM ABRASION RESISTANCE . . .**
EXCELLENT PUNCTURE RESISTANCE . . .
MAXIMUM RESISTANCE TO SOIL STRESS . . .

PLUS **EXCELLENT ELECTRICAL PROPERTIES**

SPECIFY

REG. U.S. PAT. OFF.

SCOTCHRAP BRAND **Pipe Protection Products**

The term "SCOTCHRAP" is a registered trademark of Minnesota Mining and Mfg. Co., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

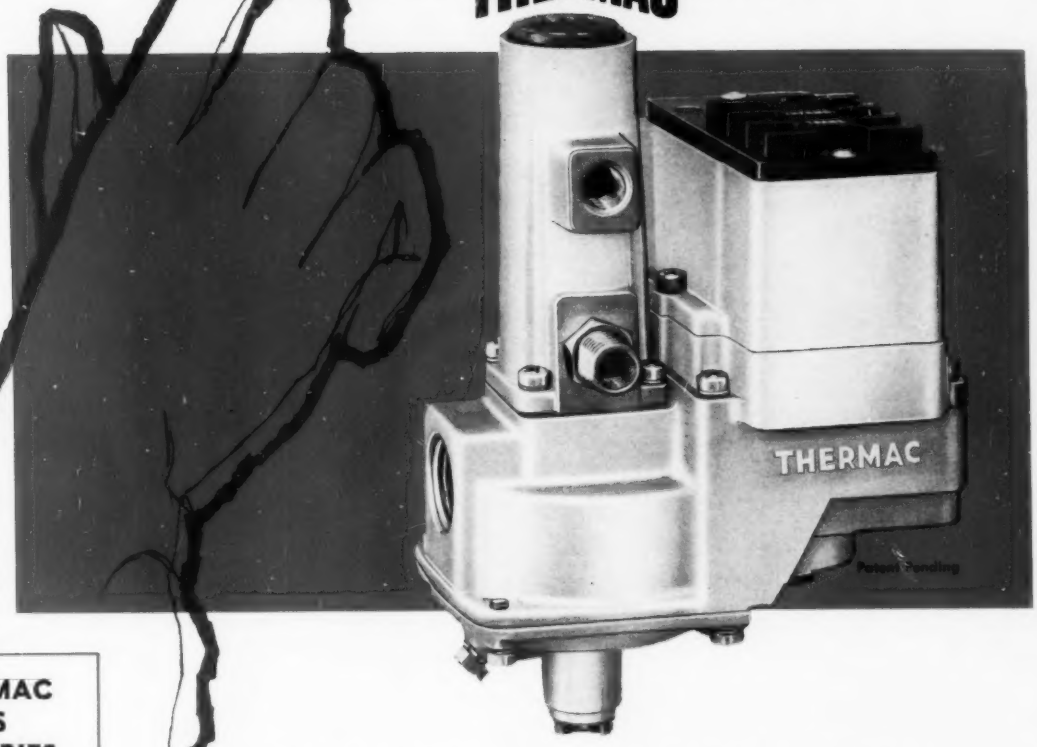
MINNESOTA MINING AND MANUFACTURING COMPANY
. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

Smooth, Silent, Controlled Ignition

WITH THE

NEW THERMAC CONTROL



THERMAC SLS 400 SERIES

Here is the competely automatic gas control valve that provides *tip-toe quiet ignition* of gas appliances—Thermac's new, exclusive control. It gives *absolute control* of ignition, regardless of supply input. A special small valve opens first to admit the required volume of gas for proper ignition, followed by balanced opening of a second valve for normal full flow.

This new "step-flow" design is important. It eliminates flame roll-out, can simplify and save on fire-box construction, does away with need for shielding. *There is no ignition noise,* making the unit ideal for closet installations and similar applications. Thermocouple operated safety with 100% shut-off feature is employed. An exclusive patented precision gas regulator is utilized in this combination.

Make Thermac's silent control a strong selling feature for *your* appliances. It is thoroughly tested and approved, comes to you factory adjusted, ready to install. No further adjustments are required. Full details —including test samples—are available. *Write Thermac today!*

THERMAC
COMPANY

Certified by A.G.A.

"27 years' experience building gas controls"

Distributed in Canada by Ontor, Limited.

14296 EAST SIXTH STREET • CORONA, CALIFORNIA • REdwood 7-3511

LGP-30

ROYAL PRECISION

Electronic digital computer solves distribution problems on networks of up to 1000 pipe sections and 400 loops by Hardy Cross method

Gives you optimum level efficiency in distribution, transmission, storage!

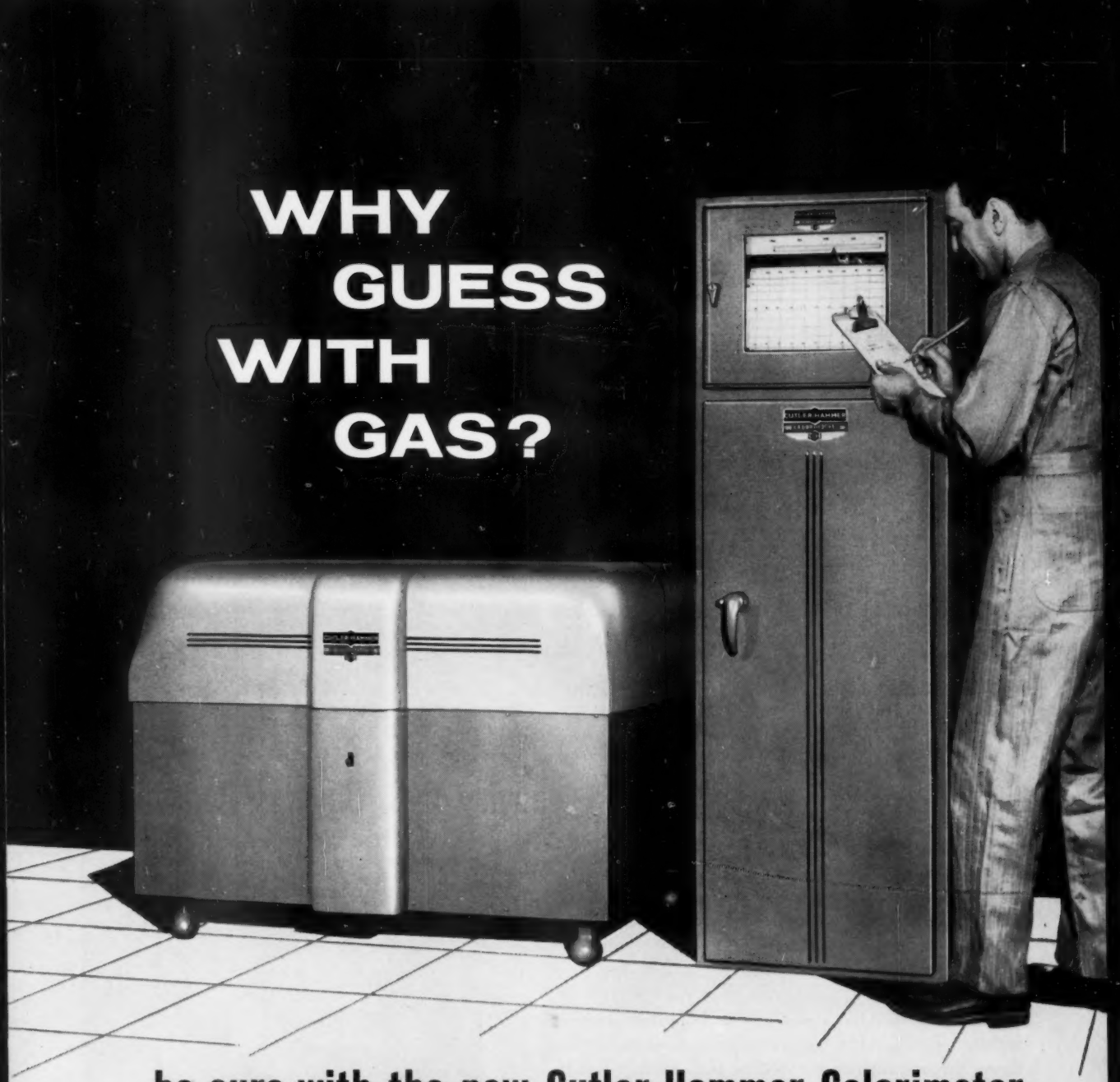
Operating from any convenient wall outlet, the compact, powerful LGP-30 is used at *desk-side* for the solution of such problems as network distribution, gas reservoir calculations for storage and production wells, high pressure gas transmission studies, mechanical design of pipelines and compressor stations. Result: you get the fast, accurate answers you need to insure peak operating efficiency. And at the lowest cost ever for a complete computer system!

Combining large memory (4096 words) and stored-program operation, the LGP-30 gives you twice the capacity of any computer in its class . . . is by far the easiest to program in basic machine language. Answers are printed out directly—require no deciphering. What's more, auxiliary high-speed input-output equipment is available for system expansion.

No expensive installation or air-conditioning required. Customer training is free. An extensive library of programs and sub-routines is available—as well as membership in an active users organization. Sales and service facilities are maintained coast-to-coast.

For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N. Y. In Canada: The McBee Company, Ltd., 179 Bartley Drive, Toronto 16.

ROYAL McBEE • *data processing division*



. . . be sure with the new Cutler-Hammer Calorimeter

Buying gas without accurate knowledge of the exact heat content is "blind buying" . . . a sure way to pay too much for too little. Selling gas without knowing the exact heat content is "blind selling" . . . and almost always results in supplying *more* heating value than the contract specifications require "just to be on the safe side." Both practices can undermine profits.

Whatever your interests or requirements may be, it doesn't pay to guess with gas. You can avoid the perils of blind buying and blind selling by using the new Cutler-Hammer Calorimeter. With guaranteed accuracy of 0.5%, this dependable calorimeter reveals and records the exact Btu content per standard cubic foot of gas . . . regardless of pressure, temperature, or flow variables.

Modernize your gas measuring facilities now with the new Cutler-Hammer Calorimeter. The savings afforded by its increased accuracy will quickly return your investment.

Write or wire today for the new illustrated catalog, EN48-N284. Cutler-Hammer Inc., Milwaukee 1, Wisconsin

CUTLER-HAMMER CONTROL CH

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wis. • *Division:* **Airborne Instruments Laboratory.** • *Subsidiary:* **Cutler-Hammer International, C. A.**

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation.

THE U.S. TREASURY SALUTES THE PETROLEUM INDUSTRY

—and its thousands of employees who help strengthen America's Peace Power by buying U.S. Savings Bonds

People in America's petroleum industry take pride in the vital role of their products and services in the national defense and domestic economy. This year the petroleum industry celebrates its first century and features the slogan "Born in freedom . . . working for progress."

Thousands upon thousands of these people find personal satisfaction, too, in helping to strengthen America's Peace Power through regular purchase of U.S. Savings Bonds. The use of the Payroll Savings Plan makes this sound practice convenient and easy.

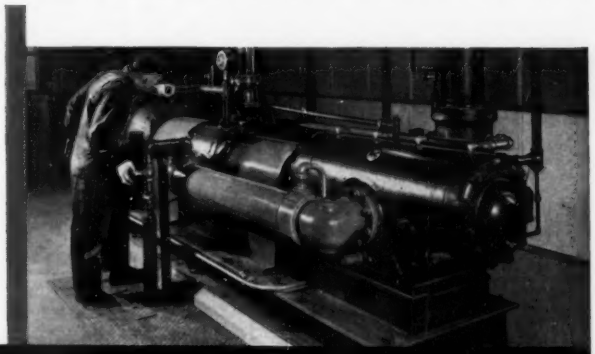
If your own company does not have a Payroll Savings Plan in operation at present, take one of these two easy steps to start one and help your people to "Share in America." Your State Savings Bond Director is anxious to help. Telephone him now. Or write to Savings Bond Division, U.S. Treasury Department, Washington, D. C.

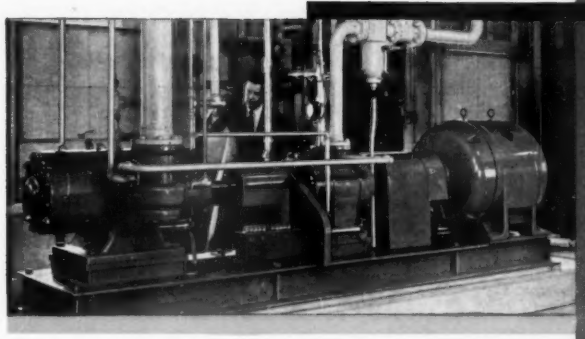
L. P. HOLLAND, skilled refinery technician, is typical of thousands of key employees in this field who are buying U.S. Savings Bonds regularly. Mr. Holland, through his company Payroll Savings Plan, is making a personal contribution to the Peace Power of our country.

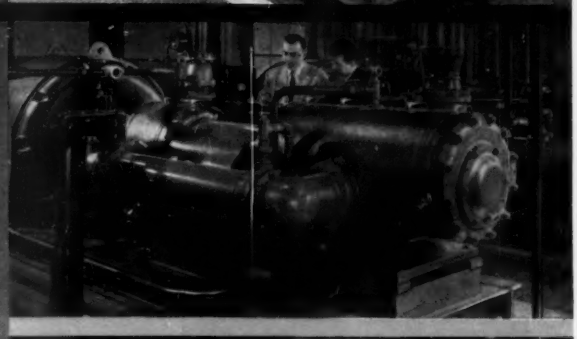
GAS MAGAZINE

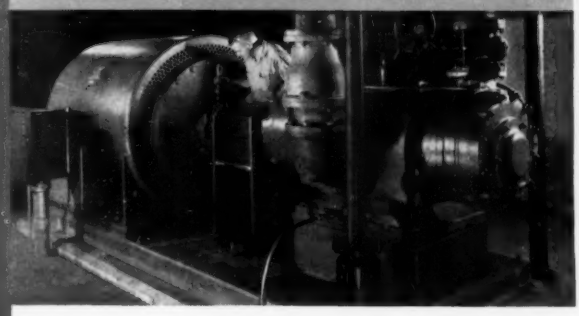
THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

for modern gas service









RO-FLO Compressor Smoothness

...for peak shaving

Ro-Flo compressors are widely used for peak shaving operations. Some of the reasons for this acceptance of Allis-Chalmers rotary compressors are:

- Grouting requirements are small, because *Ro-Flo* compressors are rotating units with practically no vibration.
- Units are compact — fit in small floor space.
- There is minimum exposure of moving parts for operator safety.
- Controls are simple and easy to reach.
- Construction is package type . . . easy to install.
- They are easy to adapt to gas engines, steam turbines or motor drives.

Not shown is the maintenance simplicity inherent in the design.

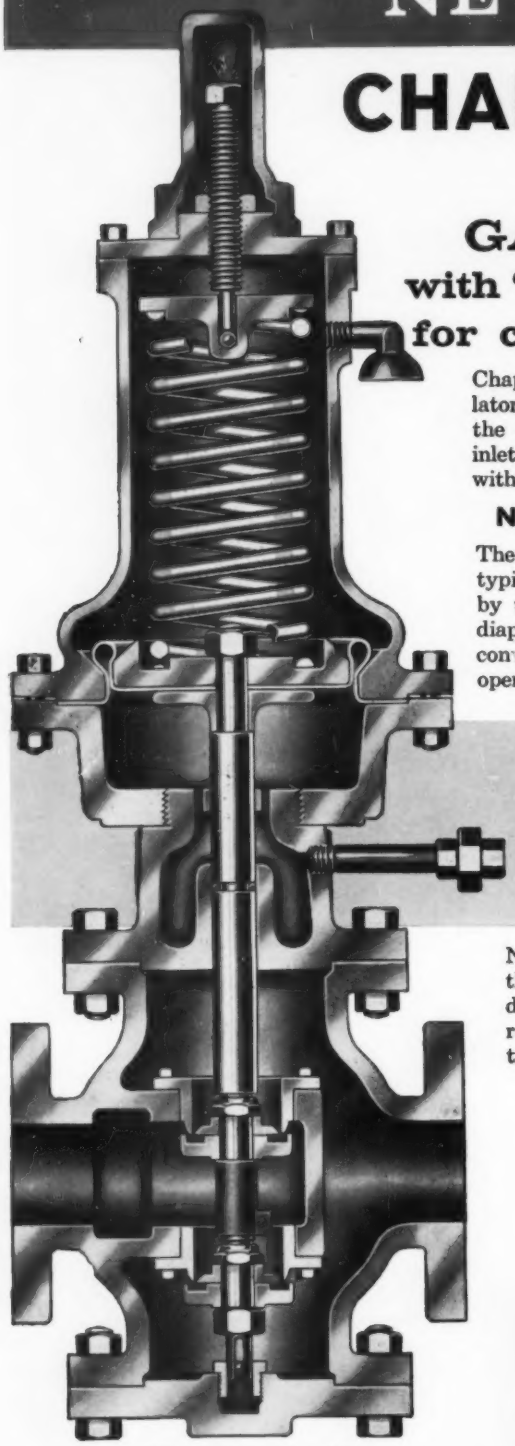
A wide range of sizes is available to fit any need. For details on Allis-Chalmers compressors, as well as motors, control and other components for peak shaving, *contact your nearby A-C office or Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.*

Ro-Flo is an Allis-Chalmers trademark.

A-1030

ALLIS-CHALMERS

NEW IN PRINCIPLE!
NEW IN DESIGN!



2" - 3" - 4" - 6"
Write for Bulletin 57-S

CHAPLIN-FULTON

Model 57-S

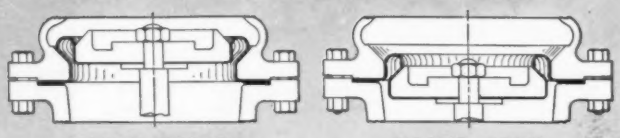
GAS REGULATOR
with "ROLL-OUT" Diaphragm for constant pressure control

Chaplin-Fulton Model 57-S is a simple spring loaded regulator which performs like a pilot loaded regulator, without the added complications. For pounds-to-pounds service—inlet pressures to 400 psi—controlled pressures to 75 psi, with deviation through full valve travel less than 1 psi.

NO "FALL-OFF" AS FLOW INCREASES

The drooping characteristics or outlet pressure "fall-off", typical of conventional spring regulators, is eliminated—not by using an uncontrollable velocity effect—but by a new diaphragm design which actually reverses the action of a conventional diaphragm. It changes its area as the valve opens to compensate for the loss in spring loading force.

"ROLL-OUT" DIAPHRAGM PRINCIPLE



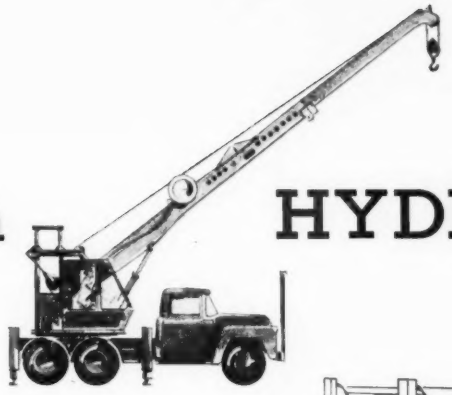
VALVE CLOSED VALVE OPEN

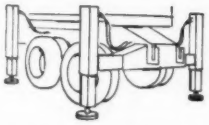
Note how, with the valve upwards in the closed position, the diaphragm achieves its maximum effective area—and decreases as the valve opens. The area changes at the same rate as the spring loses compression, to give a constant controlled pressure—determined entirely by valve movement.

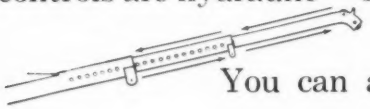
ACCURATE CF MFG. CO DEPENDABLE

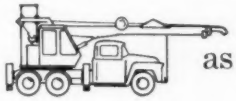
Chaplin-Fulton
MANUFACTURING COMPANY
Pittsburgh 25, Pennsylvania

This is a HYDROCRANE!



It will lift 24,000 pounds. Its outriggers  operate hydraulically and individually — within seconds to keep you level when you work. The controls are hydraulic — oil-smooth. The boom on a Hydrocrane is telescoping.



You can add 12 feet to your reach *on the move*, without stopping! The standard boom can be 24 to 36 feet long, the high lift boom can be 38 to 50 feet long — or even 70 feet long with the jib! The Hydrocrane travels over streets, highways, in plant yards  as easily and fast as your pickup trucks. Does it work? It works so well that over 50% of the customers* who have ever bought a Hydrocrane, have bought another!

*Who are they? They're loggers, contractors, steel erectors. They're municipalities, utility companies and precast concrete people. And, there are many more every day. **See your Hydrocrane distributor for a free demonstration,** or write Dept. 36H, Bucyrus-Erie Company, South Milwaukee, Wisconsin.

BUCYRUS ERIE

Builds Better Equipment

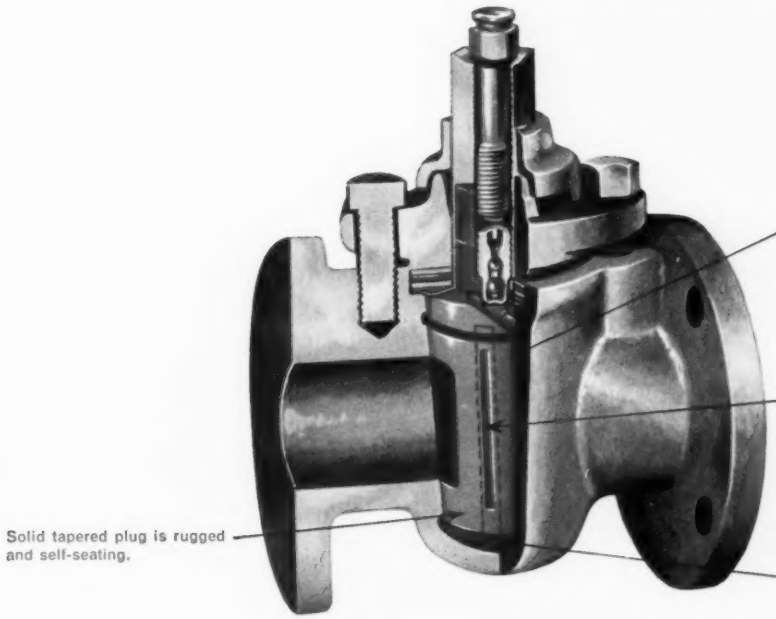
ROCKWELL-Nordstrom **VALVES**

Just a little leak?

Little leaks . . . unless they're stopped . . . sink big ships. And valves with little leaks cost industry millions of dollars every year. In terms of dollars and cents and human lives, there's no such thing as a "little leak."

Valves that leak "just a little" mean ever-increasing product loss, product contamination, or hazards. That's why wherever the safety, precision or economy of flow control dictates that even little leaks can't be tolerated, you'll see Rockwell-Nordstrom lubricated plug valves.

LUBRICANT-SEALED FOR POSITIVE SHUT-OFF


Seats never exposed to line . . . permanent, positive shut-off.
Pressurized lubricant in Sealdport® grooves forms impenetrable seals against leakage . . . lubricant is instantly replaceable seat that can't "wear out."
Solid tapered plug is rugged and self-seating.
Pressurized lubricant hydraulically cushions plug for instant, quarter-turn closure.

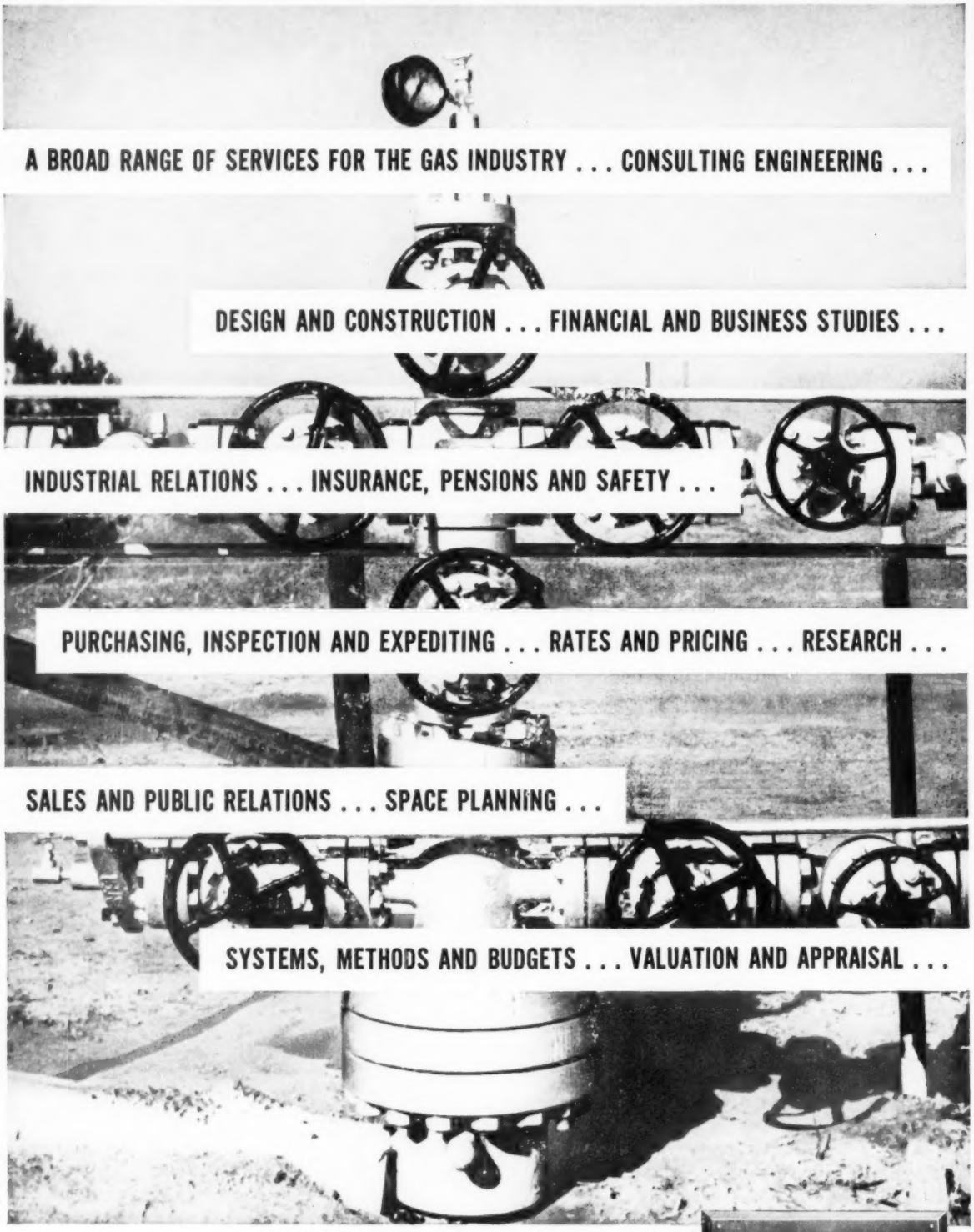
Rockwell-Nordstrom is the original and world's most complete line of lubricated plug valves with sizes from ¾" to 36" and pressures to 15,000 lb. Available at leading oil field and industrial supply houses everywhere. For details, see your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. If you live outside the U. S. A., write: Rockwell International Division, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

®Reg. T.M. Rockwell Manufacturing Company


A BROAD RANGE OF SERVICES FOR THE GAS INDUSTRY . . . CONSULTING ENGINEERING . . .
DESIGN AND CONSTRUCTION . . . FINANCIAL AND BUSINESS STUDIES . . .
INDUSTRIAL RELATIONS . . . INSURANCE, PENSIONS AND SAFETY . . .
PURCHASING, INSPECTION AND EXPEDITING . . . RATES AND PRICING . . . RESEARCH . . .
SALES AND PUBLIC RELATIONS . . . SPACE PLANNING . . .
SYSTEMS, METHODS AND BUDGETS . . . VALUATION AND APPRAISAL . . .

For a complete outline of the services Ebasco offers, send for "The Inside Story of Outside Help." Address Ebasco Services Incorporated, Dept. F., Two Rector Street, New York 6, N. Y.

ENGINEERS · CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

NEW YORK · CHICAGO · DALLAS · PORTLAND, ORE. · SAN FRANCISCO · WASHINGTON, D. C.

Why drill services?
PUNCH 'em!

A new way for taking services off mains. A quick, safe welding tee that incorporates in each tee a punch and positive shut-off . . . doing away entirely with the use of drill devices. Punch size, ⅜" or smaller.

We also have a model for use with saddles, threaded at the base to screw into the saddle.

Each tee is tested to 5,000 p.s.i. hydraulic pressure, and carries "Rated 1,000 pounds". A 5 to 1 safety factor. A real high pressure tee. Made from steel similar to pipe, it welds easily, and in the saddle model, takes a perfect thread.

Made in two sizes, ¾" and 1". Side outlet can be furnished ¾" or 1", end beveled for welding, standard pipe size, either threaded, or smooth for compression coupling. Or outlet can be internally threaded for ½" pipe size.

With this tee you will be forever free from the cost of drilling machines, broken drills and drill machine maintenance and repairs. We feel this tee is the finest service improvement ever offered to the gas industry. Write for circular with installation instructions.

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

SKINNER-SEAL PUNCH-IT TEE

A. Standby pilot—tubing to manifold. Only 100 btu/hr . . . means a really cool oven.

B. Igniter pilot—tubing to oven control. Operates only when the oven is used. Good size flame means positive igniting and easy installing.

C. Lightning-fast vapor-pressure thermal system powers the gas valve. Flexible capillary cuts the mounting cost.

FLAME MASTER Automatic Pilot

ENDS "TWO-WAY" STRETCH!

No more red buttons to push, no more strings to pull! No more service calls to re-light pilots. Here's a new type Robertshaw automatic oven pilot that women will look for and demand.

It's a big feature that dealer salesmen will push on 1959 gas ranges.

The FLAME MASTER automatic pilot is an entirely new type for ovens and broilers. It's powered by a *vapor-pressure* thermal system that's lightning-fast. And its *two-stage* pilot ends the need for push buttons and pull strings.

Used in combination with the Robertshaw BJ oven control, this new *low-cost* automatic pilot is the perfect answer to the automatic ignition requirement.

It costs less than conventional automatic pilots. And it costs less to install . . . *flexible* capillary between the valve and the pilot. You can mount the valve upside down if you like . . . and there's no critical positioning of the pilot assembly.

Trouble free, long life is assured by Robertshaw and you'll know why when you see this new FLAME MASTER automatic blue flame pilot. The design is simple and trouble-free. And the components have been time and field-proven in millions of gas appliance controls.

Write today for bulletin RT-867. **Robertshaw Thermostat Division, Robertshaw-Fulton Controls Company, Youngwood, Pennsylvania.**

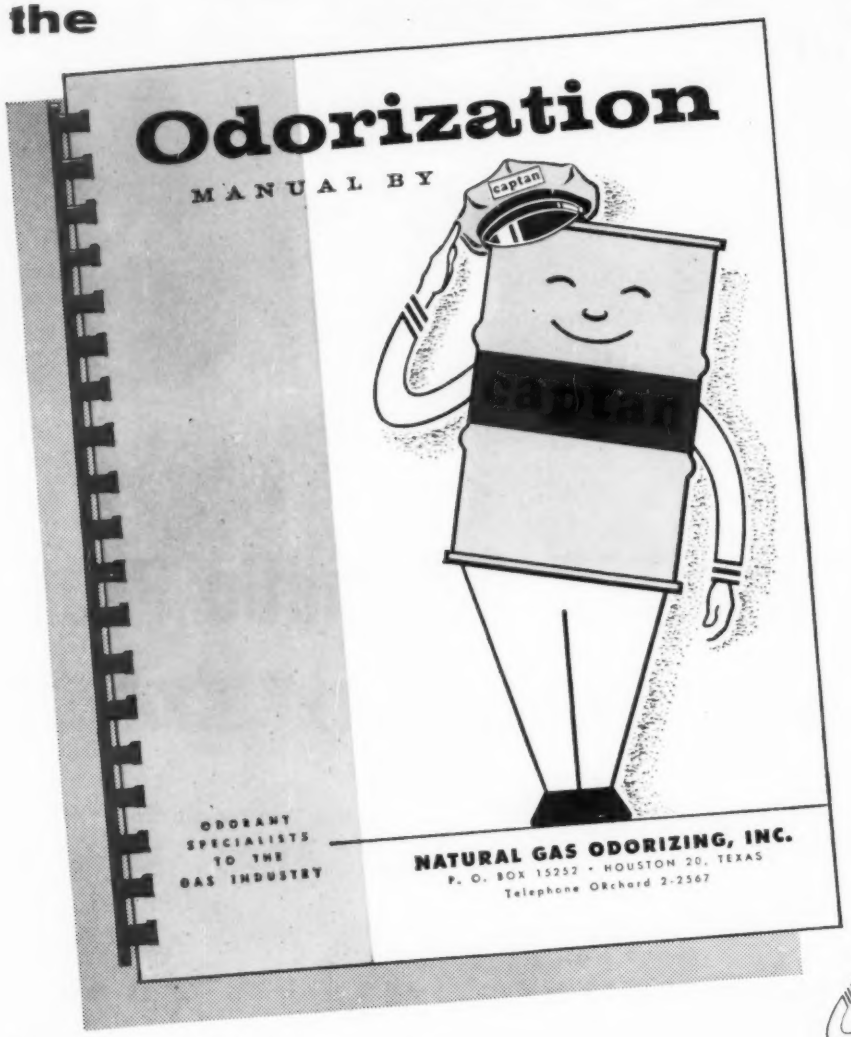
Robertshaw

MR. CONTROLS

RT 108-59

COMPARE

ANY other odorization guide with the



Operating men tell us:

"Excellent—Very comprehensive"

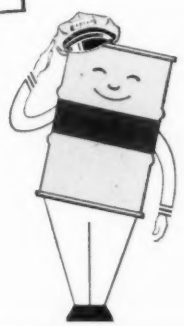
"Wonderful"

"Thanks very much for an informative, interesting guide to odorization"

"Thanks—nice compendium—up to date"

"An excellent reference and text"

"A splendid job"



ASK FOR THE NEW COMPLETE "ODORIZATION MANUAL BY CAPTAN"

● ***Don't delay . . . phone, wire or write us today!***

NATURAL GAS ODORIZING, INC.

P. O. BOX 15252 / HOUSTON 20, TEXAS

Now! An all-bronze replacement

MUELLER® *inverted key gas curb stop*

. . . for use with copper service lines!

Now you can use Mueller inverted key gas curb stops when replacing old, dangerous ¾″ iron pipe service lines with new ½″ copper pipe. Simply cut out the old curb stop, push the new copper pipe through the inside of the old iron pipe, and connect a Mueller H-11309 Curb Stop to the new copper pipe.

This new Mueller Curb Stop is similar in design to Mueller's well-known Inverted Key curb stops. All of the superior features of this excellent design have been retained. However, this new stop, specifically designed for use with copper pipe, is of all-bronze construction to eliminate dissimilar metals and reduce corrosion caused by galvanic action.

This special application product is typical of the attention to detail in research, design and engineering that becomes a part of every Mueller product made for the gas industry.

Write for complete information.

H-11309 Inverted Key Gas Curb Stop
All-bronze with Straight Way and Flat Head
Inlet and Outlet: Dresser Coupling Style 88 for Type "K" Copper Pipe
Size: ½" only

NO-BLO®

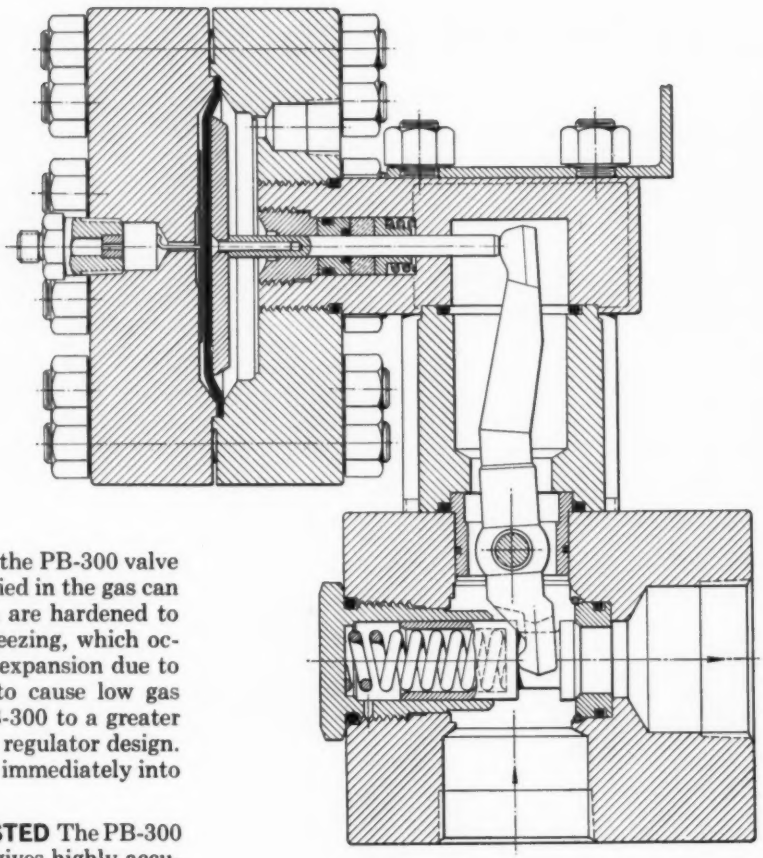
GEM

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

GROVE PB-300... Remarkable resistance to sand cutting and freezing

Adapts easily for Pressure Regulation, Back Pressure Service and Automatic Over Pressure or Under Pressure Shutoff



Available in both Angle (shown above) and In-line models with 2" screwed or ring joint flange connections. Inlet pressures to 6000 psi and controlled pressures to 3000 psi.

The flow of high pressure gas through the PB-300 valve is *away* from working parts. Sand carried in the gas can attack only the valve and seat which are hardened to resist cutting and easily replaced. Freezing, which occurs in ordinary regulators when gas expansion due to pressure reduction is great enough to cause low gas temperatures, is minimized in the PB-300 to a greater extent than is possible with any other regulator design. Gas flow through the valve is directed immediately into the unobstructed downstream line.

HIGHLY ACCURATE-EASILY ADJUSTED The PB-300 is very easy to install and adjust. It gives highly accurate pressure control and is one of the most dependable regulators on the market today. Effects of ambient temperature changes can be greatly reduced by burying the cylinder containing the dome loading pressure.

VERSATILE The PB-300 can be used for pressure reducing, back pressure regulation, or as an automatic over *or* under pressure shutoff valve without any change in parts or construction. Merely attach the control lines for the service desired. Addition of a small pilot valve converts it to an automatic over *and* under pressure shutoff valve.

The Grove PB-300 uses the field proven Powreactor Dome principle—demonstrated over the years in thousands of regulating and well head protection installations.

Write today for Bulletin 126-B giving complete information

GROVE VALVE and REGULATOR COMPANY

A Subsidiary of Walworth

65th & Hollis Street, OAKLAND 8, California

HOUSTON 27—3203 Mercer St. • LOS ANGELES 6—2559 W. Olympic Blvd.

ODESSA • TULSA • DENVER • CHICAGO • NEW YORK • DALLAS • PITTSBURGH

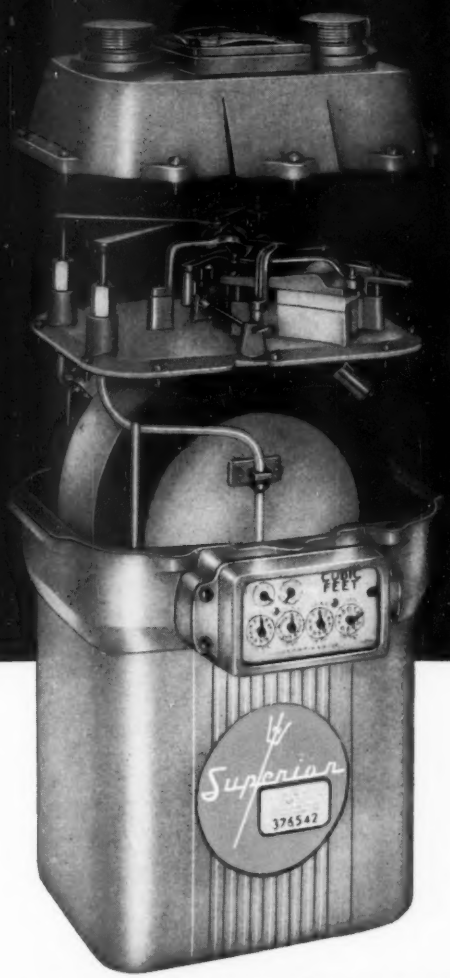
FARMINGTON, N. M. • LAFAYETTE, LA. • HARVEY, LA. • LONGVIEW, TEXAS

In Western Canada: GROVE VALVE LTD., EDMONTON

8575

16 REASONS
SUPERIOR Aluminum Case METERS

give you Long-term Accuracy . . .
. . . Easy Maintenance . . .
. . . High Customer Appeal



1. **Slow movement...**
2. **Simple horizontal seam... easily sealed.**
3. **Accessible table... just remove the screws holding top.**
4. **Meter top removable without disturbing index box.**
5. **Valves readily accessible when top is removed.**
6. **Seam gasket stays resilient...**
7. **Entire mechanism lifts out with valve table.**
8. **Heavy-duty, sintered bronze bearings oil-impregnated for life.**
9. **Flag arrangement gives arm smooth operation and longer life.**
10. **Accurately-controlled diaphragm... no inaccuracies from deflection.**
11. **Cupped side flanges permit easy and safe carrying.**
12. **Calibration through convenient hand hole.**
13. **Broad base for conveyorized handling. Flats on top permit solid stacking.**
14. **Index removable without disturbing meter.**
15. **Modern appearance for quick customer acceptance.**
16. **Conforms to latest A.G.A. standardization specifications.**

Superior now manufactures aluminum case meters in 175 cfh, 250 cfh and 340 cfh sizes to meet most domestic requirements. To find out how this advanced-design meter will fit into your planning send for bulletin 1150... or, better still, phone the Superior representative nearest you. He understands your needs and stands ready to give you good, quick service.

SUPERIOR METER COMPANY, INC.

19 West 50th Street, New York 20, N. Y.

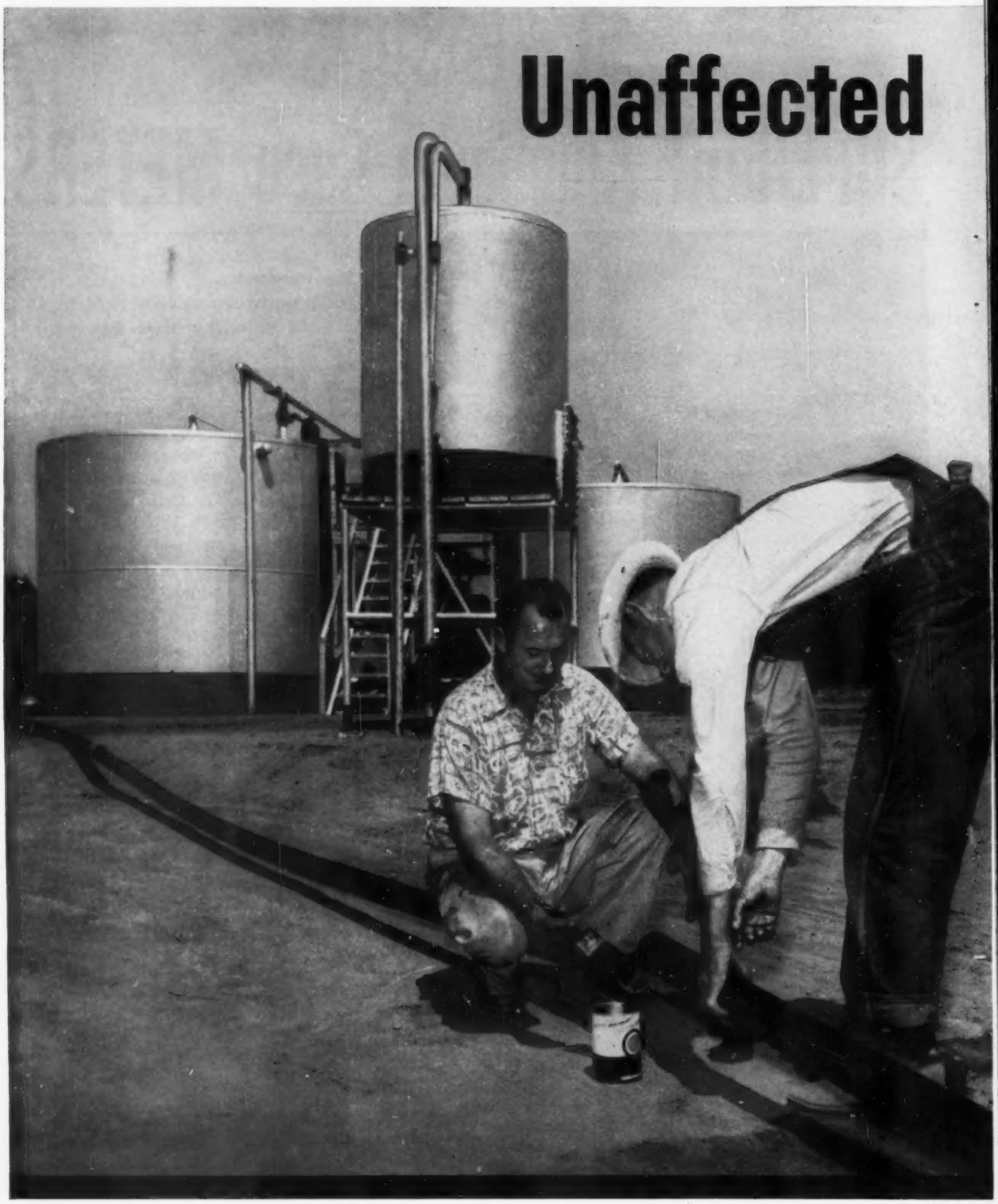
A SUBSIDIARY OF NEPTUNE METER COMPANY

neptune

Branch Offices: Atlanta • Boston • Chicago • Dallas • Denver • Los Angeles Louisville • New York • North Kansas City, Mo. • Philadelphia Portland, Ore. • San Francisco

In Canada: Neptune Meters Ltd. • Toronto • Calgary • Halifax Montreal • St. John • Vancouver • Winnipeg

15



PERMANENT JOINTS CAN BE MADE IN SECONDS . . . when the pipe is Republic SRK. And, above-ground lines can be moved about easily as needs change. Ordinary handsaw is all that is required for fast, accurate cutting. Brush-applied solvent and plastic fittings "weld" joints in a fraction of the time required by conventional lines.

by Crude, Brine, or Soil...

REPUBLIC SRK PLASTIC PIPE

First-cost is last cost! Republic SRK Plastic Pipe is unaffected by crude oil, brine, or raw gas. It is inert to the most severe acid or alkaline soil, immune to electrolytic action. Yet despite these replacement savings, SRK costs no more to buy than ordinary pipe.

Installation savings bring first-cost down even more. With SRK, economical brush-applied solvent and plastic fittings permit any type of joint to be made in seconds. Pipe is lightweight and easy to handle. Cuts with ordinary handsaw. And, it can be installed in combination with existing pipe lines.

Produced by the steel pioneer in plastic tubular products, SRK is available in a wide range of pressure ratings and sizes from ½″ through 6″. Republic also makes Semi-Rigid Butyrate (SRB) for extreme paraffin conditions. Both types are characterized by low friction loss as well as exceptional uniformity and toughness. Both types can weather rough handling without damage.

Learn more about pipe that costs no more to buy —far less to install—virtually nothing to keep in service. For complete information and specifications on Republic SRK and SRB, mail the coupon today.

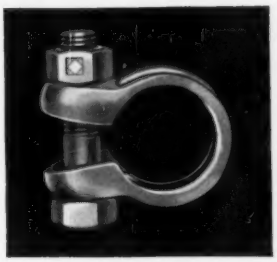
REPUBLIC STEEL
CLEVELAND 1, OHIO

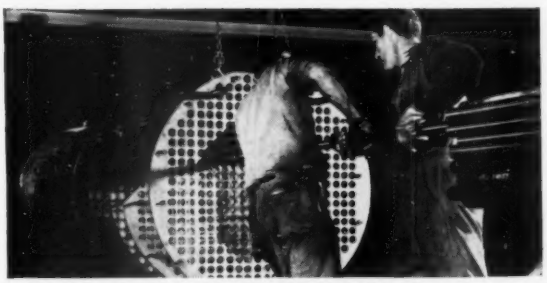
World's Widest Range of Standard Steels and Steel Products

REPUBLIC CAN ALSO HELP YOU...

MEET EXTREME ABRASION AND IMPACT REQUIREMENTS with Republic Alloy Steels. Their greater strength and toughness, plus superior abrasion, impact, and corrosion-resistance permit use of smaller, lighter cross sections. Result is fully safe, dependable equipment, of minimum weight and bulk. Applications include tongs, bits, blocks, elevators, draw-works parts. Send for data.

MEET EXTREME FASTENING REQUIREMENTS with Nylok® Bolts and Nuts. Secure lock is produced by nylon pellet imbedded in body of fastener as shown (top nut). In use, pellet is deformed, setting up a permanent lateral thrust. As a result, opposite threads produce a strong, metal-to-metal lock, whether or not fastener is seated. Nylok Fasteners are fully adjustable and re-usable. Mail coupon for details.





MEET EXTREME PERFORMANCE SPECIFICATIONS with ELECTRUNITE carbon or stainless steel Heat Exchanger Tubes. ELECTRUNITE is formed from highest quality flat-rolled open-hearth or electric furnace steel and welded by Republic's exclusive ELECTRUNITE process that unites the tube without the addition of foreign metal. FARROWTEST®, a proved production safeguard that detects and rejects tubing with defects of critical size, is offered as an alternate to other less positive tests . . . at no extra cost. Mail coupon.

REPUBLIC STEEL CORPORATION
DEPT. GS -7547
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send more information on:

- ☐ SRK and SRB Plastic Pipe
- ☐ Republic Alloy Steels
- ☐ ELECTRUNITE® Heat Exchanger Tubes
- ☐ Nylok Bolts and Nuts

Name_____ Title_____

Firm_____

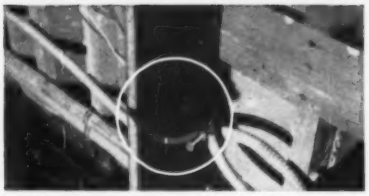
Address_____

City_____ Zone_____ State_____

Versatile MARMAN Combination

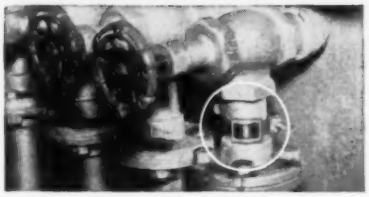
SOLVES MAINTENANCE PROBLEMS

MARMAN UNIVERSAL BAND CLAMP FITS TIGHT, STAYS TIGHT



It adjusts to any diameter, any shape; withstands sustained vibration. Fastens quickly with thumb screw for permanent installation or temporary use. Corrosion resistant band of stainless steel. Four band lengths fit all diameters from ¼" to 16⅛".

. . . ADD A PATCH TO REPAIR PIPE LEAKS



Slide a Marman pipe leak patch on the Universal Band Clamp to make a Marman PATCHMASTER* Clamp. Synthetic rubber patch conforms to pipe shape, holds pressures up to 800 psi., won't collapse weak pipe. Fits sizes up to 9⅛" diameter.

. . . OR, ADD A FLAG TO IDENTIFY AND INSTRUCT

Eliminate mistakes and delays by identifying lines and equipment with the Marman FLAGMASTER*. Put message on 2" x 4" flag, slide flag on Universal Band Clamp and attach to any pipe, pole or stand from 2⅜" to 16" in diameter.

*FLAGMASTER and PATCHMASTER are Aeroquip Trademarks

Order This Versatile Band Clamp Combination Today Through These Distributors:

ARIZONA
GARRETT SUPPLY CO.
2950 W. Thomas Rd., Phoenix, AP 8-5511

CALIFORNIA
BEARING & EQUIPMENT CO.
52-56 Locust, San Jose, CY 3-7309
BOLSTAD SALES & SERVICE
124 E. 4th Street, San Pedro, TE 2-7582
GILMORE SUPPLY CO.
821 Folsom Street, San Francisco 7, DO 2-5242
HOFFMEYER BELTING & SUPPLY
541 E. 8th St., Oakland, TE 4-8636
WARREN AND BAILEY
3528 S. Garfield, Los Angeles, RA 3-7181
WARREN AND BAILEY
2305 E. Belt Street, San Diego, BE 9-9491
WINN SUPPLY CO.
1676 Main St., San Diego, BE 3-3106

CANADA
AEROQUIP (CANADA) LTD.
287 Bridgeland Ave., Toronto 19, RU 1-5261

COLORADO
MINE AND OIL SUPPLY CO.
1111 S. 7th Street, Grand Junction, CH 3-3411
PLANT EQUIPMENT CO.
1400 Market Street, Denver 2, AL 5-5411

CONNECTICUT
NIELSEN HYDRAULIC EQUIP. INC.
9 Grassmere Ave., W. Hartford, AD 3-2691

ILLINOIS
ILLINOIS AUTO ELECTRIC CO.
2001-37 Indiana Avenue, Chicago 16, CA 5-4444

ILLINOIS (Continued)
TRANSMISSION SUPPLY CO.
926 N. Knoxville Ave., Peoria, 3-3666
TRANSMISSION SUPPLY CO.
1514 Seventh Ave., Rock Island, 8-6333

INDIANA
BRIGGS DISTRIBUTING CO., INC.
1951 Central Ave., Indianapolis 2, WA 4-2641
TRANSMISSION SUPPLY CO.
1844 W. 16th Street, Indianapolis, ME 7-5471

MICHIGAN
UTILITY & IND. SUPPLY CO.
921 Michigan Ave., E., Jackson, ST 9-6194
UTILITY & IND. SUPPLY CO.
116 N. Franklyn St., Mt. Pleasant, SP 3-3781
UTILITY & IND. SUPPLY CO.
702 E. Maumee, Adrian, CO 5-6151
F. B. WRIGHT CO.
9999 Mercier Ave., Dearborn, VI 3-8250

MINNESOTA
CARDON DISTRIBUTORS
4147 Minnehaha Ave. S., Minneapolis 6, PA 4-5748

NEBRASKA
ENGINEERED SALES CO.
116 N. 40th Street, Omaha, RE 9110

NEVADA
STANDARD WHSL. SUPPLY CO.
855 W. Bonanza, Las Vegas, DU 2-6930

NEW MEXICO
EQUIPMENT SALES & MFG. CO.
1018 Fourth St., N.W., Albuquerque, CHapel 3-6769

NEW YORK
ENGINE EQUIPMENT SERVICE
1480 Williamsbridge Road, New York 61, TA 3-6590
NIELSEN HYDRAULIC EQUIP. INC.
6 Penn Place, Pelham Manor, PE 8-3000

OHIO
BURR OAK BELTING & RUBBER CO.
309 Findlay St., Cincinnati 14, MA 1-5474
UTILITY & INDUSTRIAL SUPPLY CO.
268 E. Pearl Street, Lima, CA 5-6080

OREGON
GOODYEAR RUBBER & ASBESTOS CO.
205 N. W. Fifth Avenue, Portland 9, CA 8-8575

PENNSYLVANIA
RONCO CORPORATION
Blue Bell, TA 8-2150

TENNESSEE
BERRY EQUIPMENT CO.
905 Union Ave., Memphis 3, JA 5-0496

TEXAS
AIRSCO RUBBER PROD., OF DALLAS, INC.
1039 Levee, Dallas, RI 2-4151
W. H. STEIGERWALD CO., INC.
2119 Dallas Avenue, Houston 3, CA 7-9106

UTAH
WILSONS TRANSPORT SUPPLY
665 S. State St., Salt Lake City, EM 3-3948

WASHINGTON
SPENCER AIRCRAFT INDUSTRIES, INC.
8410 Dallas Ave., Seattle 8, PA 3-0911
TOWNE EQUIPMENT CO.
622 N. Monroe, Spokane 1, FA 8-1540

MARMAN DIVISION
Aeroquip Corporation

Industrial Sales Department, 11214 Exposition Blvd., Los Angeles, California

A new way of life...with GAS air conditioning

The Arkla-Servel SUN VALLEY* gas air conditioner will mean a NEW WAY OF LIFE for THE ENTIRE FAMILY.

Actually CHANGES the living pattern . . . giving MANY BENEFITS

- BETTER HEALTH
- CLEANLINESS
- INCREASED PROPERTY VALUE

and most important . . . BETTER FAMILY LIVING. Install a SUN VALLEY gas air conditioner for COMFORT . . . and ECONOMY.

FOR FURTHER INFORMATION ABOUT GAS AIR CONDITIONING, SEE YOUR LOCAL GAS COMPANY OR WRITE

ARKLA Servel
SUN VALLEY
ALL-YEAR AIR CONDITIONER

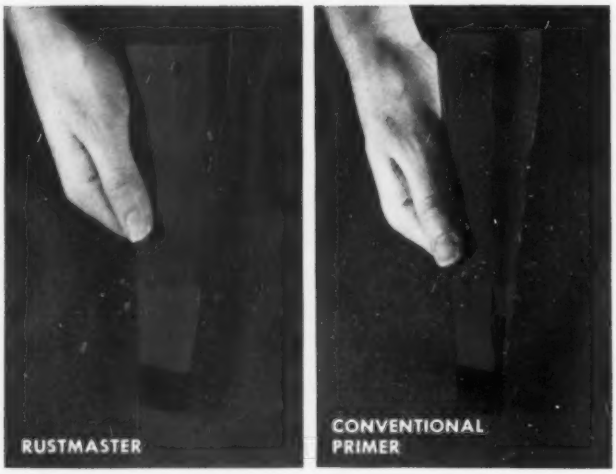
ARKLA AIR CONDITIONING CORPORATION
SHANNON BUILDING • LITTLE ROCK, ARKANSAS

ALSO ASK TO SEE THE NEW SENTRY GASLITE

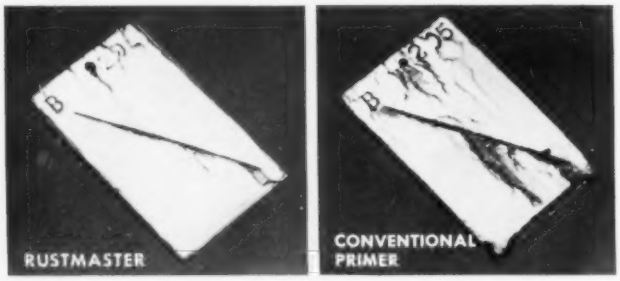
Gaslite BY ARKLA
BIGGEST NAME IN DECORATIVE OUTDOOR LIGHTING

Revolutionary Metal Primer...

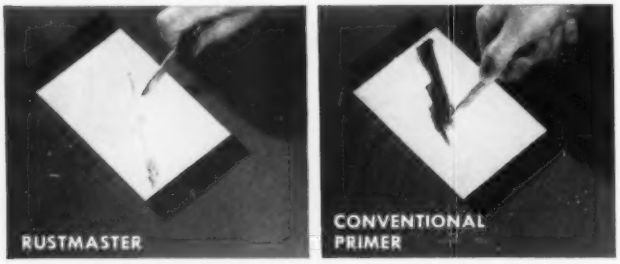
RUSTMASTER



PROOF OF BETTER ADHESION—Rusted metal sheets were coated with primers and finish coats and exposed to weatherometer at 95 degrees and 95 per cent humidity for 300 hours. They were then subjected to severe bending in conical mandrel. Conventional primer cracked and broke away from surface. RUSTMASTER showed little sign of stress revealing far greater flexibility and adhesion.



PROOF OF BETTER ENDURANCE—In salt spray test, metal panels were coated with primers and finish coats and scribed to bare metal. Panels were then subjected to salt spray test for 500 hours. "Conventional" panel had severe blistering and under-film corrosion. RUSTMASTER restricted corrosion to scribed area, proving higher anti-corrosive qualities.



PROOF OF BETTER PROTECTION—Primers were applied to rusted metal panels and exposed to weatherometer test for 1600 hours. Scraping of both panels with knife blade showed that conventional primer pigment remained on the surface of the rust. RUSTMASTER vehicle and anti-corrosive pigments were bound into the rust, proving deeper penetration, more protection.

Penetrates rust faster and more thoroughly, dries faster, and gives better protection

Secret to the remarkable RUSTMASTER performance is a special surface wetting additive*. This additive gives the vehicle and pigment in RUSTMASTER superior penetrating power through rust which remains after average surface preparation.

This protective primer pierces tight rust layers and actually forces its way to the metal surface. Once there, it bonds firmly with the substrate, driving out corrosive moisture and air remaining in microscopic pores. This bonding action produces an extremely strong, flexible, durable finish.

The swift penetrating action of RUSTMASTER makes it fast-drying, too—waiting period before applying finish coat is now hours instead of days.

So successful have been exhaustive laboratory tests, that RUSTMASTER wetting agent is now being extensively field tested by the Lead Industries Association in formulas for Red Lead and Modified Red Lead Primers, and is included in experimental formulations recommended by the Association to industry for field testing.

Write on your company letterhead for complete information.

For most efficient protective maintenance systems, use RUSTMASTER with recommended Glidden finish coatings.

*Patent applied for

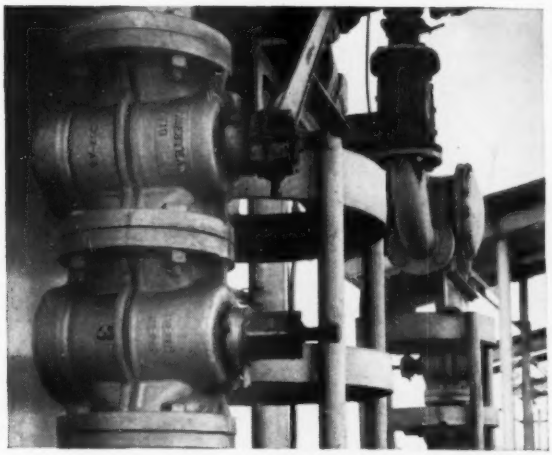
QUALITY Glidden PRODUCTS — General Paint

COATINGS FOR EVERY PURPOSE

The Glidden Company
INDUSTRIAL PAINT DIVISION
900 Union Commerce Building
Cleveland 14, Ohio

In Canada: The Glidden Company, Ltd., Toronto, Ontario

Homestead Plug Valves Help to Keep Aviation Gas Pure at Naval Air Base, Norfolk



3" Homestead Lubricated Plug Valves handling gasoline on tank truck loading docks at Naval Air Station, Norfolk

Aviation gasoline must be kept free of contamination. That's why fuel lines on truck or ship loading docks, and on underground storage tanks, are so often controlled by Homestead Lubricated Plug Valves.

Controlled pressurized lubrication system and extremely close tolerance between plug and body, prevent lubricant from being extruded into line—prevent contamination of gasoline. Add Homestead's reinforced Teflon* head seal and double ball check valve, and you have a truly dependable plug valve—one that opens quickly and fully for fast loading; closes quickly and tightly for positive fluid control.

Mail coupon today for Reference Books 39-1 and 1A, your complete library on Homestead Lubricated Plug Valves.

Send me new Reference Books 39-1 and 1A on Homestead Lubricated Plug Valves and uses.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

*®DuPont

hv

HOMESTEAD VALVE MANUFACTURING COMPANY

Box 405, Coraopolis, Pennsylvania

Three big reasons why

MODERN CAST IRON

is best for underground mains

Cast iron is the *only* underground gas main material that combines the dependability of a century of service with the modern features needed by gas utilities today. Here are 3 big reasons for specifying modern cast iron pipe:

1. LONG LIFE

Laid 121 years ago by America's first gas company—the Gas Light Co. of Baltimore—this 10" cast iron main is serving its successor, Baltimore Gas and Electric Co. Fifty-nine American gas utilities are using cast iron mains today that they installed over a century ago. *Modern cast iron pipe* has a tensile strength over 50% greater than those older mains, with more uniform wall thicknesses. Cast iron pipe installed today will perform economically 100 years from now.

2. BOTTLE-TIGHT JOINTS

Atomic explosion tests at Los Alamos failed to disturb the bottle-tight seal of cast iron pipe mechanical joints. Vibration, washouts and heavy top loads are successfully withstood by modern cast iron mains with mechanical joints. The inside design of the joint permits deflection of the pipe during and after installation.

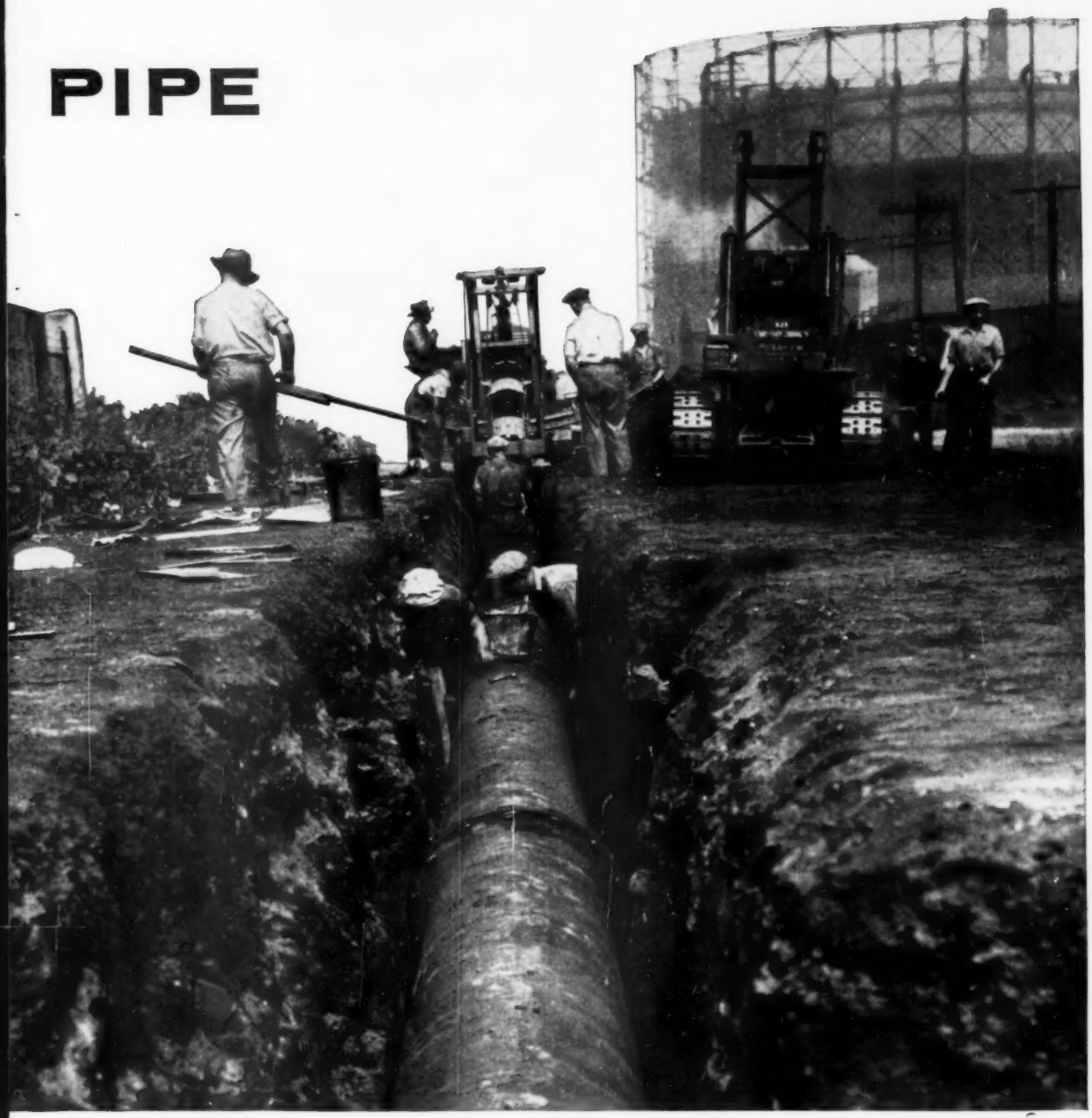
3. EASE OF INSTALLATION

Pipe laying and backfilling go faster. No bulky jointing equipment is required, and shorter lengths facilitate construction in congested areas. Utility work crews are familiar with cast iron pipe and know what equipment to take on the job. Maintenance and repair problems are simplified . . . tapping is never a problem.

Other advantages of modern cast iron pipe

- CORROSION-RESISTANCE. Cast iron pipe's long life proves its resistance to corrosion over many years, even under adverse conditions.
- GREAT BEAM STRENGTH. Cast iron pipe resists the effect of heavy traffic above . . . shifting soils below. Modern 6" cast iron pipe will deflect under beam loading as much as 3 inches.
- TREMENDOUS LOAD RESISTANCE. 6" cast iron pipe (Class 150) withstands a load of nearly 9 tons per foot!

PIPE



...All good reasons for you to choose

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

Write for complete information to Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Ill.

There are many more exclusive features in this new vertical boom ditcher.
Write for your copy of the new 16-page folder on the Model 784.

Revolutionary improvements in new VERTICAL BOOM ditcher

For city work, and all applications that encounter frequent obstacles, the new Barber-Greene Model 784 is the most advanced ditcher on the market. It combines all the proved vertical boom advantages with revolutionary operational improvements to give *unmatched performance.*

With the exclusive vertical boom, buckets come straight up, producing a trench with vertical ends and no ramps to be dug out by hand. It readily "jumps" sidewalks and underground obstructions. Its fast milling action cuts through toughest materials.

Exclusive dual-range Hydra-Crowd gives maximum digging efficiency at all speeds, makes other ditcher transmissions obsolete. Operator has infinite choice of crowding speeds which can be changed instantly without shifting gears or stopping machine. Instant reverse.

Exclusive hydraulic spoil conveyor gives instant, finger-tip control of belt speed, independent of bucket line speed, for accurate placement of spoil. Instant conveyor reverse.

Revolutionary new features include:

- New hydraulic controls for easier, more accurate operation.
- New low clearance for easiest transporting.
- New bucket line drive that cuts maintenance and down time.
- New crawlers adjustable in one-tenth the time of conventional crawlers.
- New automatic electric overload protection.
- Readily converted to wheel ditcher in the field.
- New flexible drawbar between chassis and boom.
- New dual-range Hydra-Crowd for maximum digging efficiency.
- New hydraulic spoil conveyor with instant, finger-tip control.

58-1-D

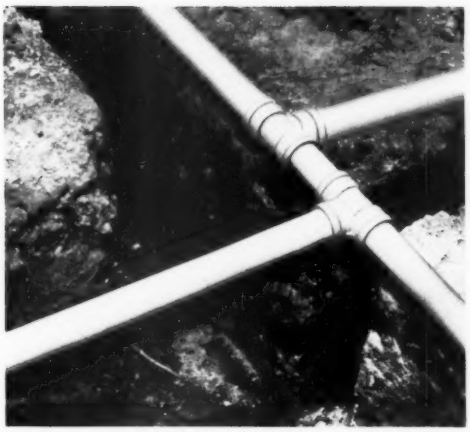
Barber-Greene BG

AURORA, ILLINOIS, U.S.A.

CONVEYORS...LOADERS...DITCHERS...ASPHALT PAVING EQUIPMENT

KRALOY PLASTIC PIPE IN THE GAS INDUSTRY

Found: THE ANSWER TO CORROSION, ELECTROLYSIS AND HIGH MAINTENANCE COSTS IN GAS LINES – *Kraloy high impact PVC Plastic Pipe provides permanent, trouble-free service at as little as 1/3 the cost!*



Narrow trenching and simple above-ground assembly of 2" mains are possible with lightweight KRALOY PVC Plastic Pipe. Fittings are "welded" on with brush and solvent.

KRALOY PVC Plastic service pipe can be led off existing plastic main by simple tapping procedure and solvent-welded plastic service tee. KRALOY is immune to rust, rot, electrolytic action.

Gas industry experts are turning in increasing numbers to *the* pipe that has proven to be most versatile and trouble-free in both main and service pipe installations—KRALOY PVC High Impact Plastic Pipe.

Impervious to galvanic or other ground corrosive actions, unaffected by electrolysis, rot or rust—KRALOY not only gets rid of sour and dirty gas headaches, but likewise most efficiently conquers other gas piping problems. KRALOY is cheaper to install. Light in weight, its flexibility and ease of making joints and bends simplifies transportation, handling and laying.

FIGHTS BOTH SOUR GAS AND COSTLY SOIL CORROSION

Quality protected by continuous laboratory control, today's KRALOY Pipe is precision extruded from basic compounds best suited to the job. With its inert, non-conductor anti-rust, rot and corrosion characteristics—and its smooth, mirror-finish interior walls that permit faster, freer output (up to 20%) through smaller pipe sizes—today's KRALOY gives you the right combination of permanent, trouble-free qualities to pipe the greatest volume of gas at the lowest cost.

KRALOY GIVES YOU THESE FEATURES

1. KRALOY is permanent—not subject to electrolysis, rot, rust or scale... needs no paint, coating, lining or cathodic protection... has the ability to withstand all ground corrosive actions.
2. KRALOY's high impact strength withstands abuse before and after installation.
3. KRALOY's lighter weight (1/8 that of steel) enables 1-man handling, lets your trucks carry more pipe footage.

"Gas Does It Better, Naturally"...*and even better* with KRALOY PVC Plastic Pipe! Available in all sizes from 1/4" to 12" with plastic fittings. Specify KRALOY for pipe *you can depend on* to do the job.

For complete information, write for brochure on Gas Industry Piping—**Kraloy Plastic Pipe Co., Inc., Dept. GM-5, 4720 East Washington Blvd., Los Angeles 22, California.**

NOTHING PIPES LIKE **KRALOY**

Another new development using

B.F.Goodrich Chemical *raw materials*

Now gas comes home through pipe of Geon

The pipe in this natural gas distribution system is made of Geon rigid vinyl. Years from now it will be feeding gas to homes just as efficiently as the day after installation. This pipe stays smooth inside and out because it is not affected by the corrosive influences that affect ordinary pipe. No problems from salt water, chemicals, acid or alkaline soils, or galvanic corrosion.

Conduit or pipe made of Geon provides high tensile and impact strength. It stands up under pressure, resisting effects of fungi, bacteria, moisture, heat or cold. It makes a big hit with installation crews, since it is so light weight and so easy to install.

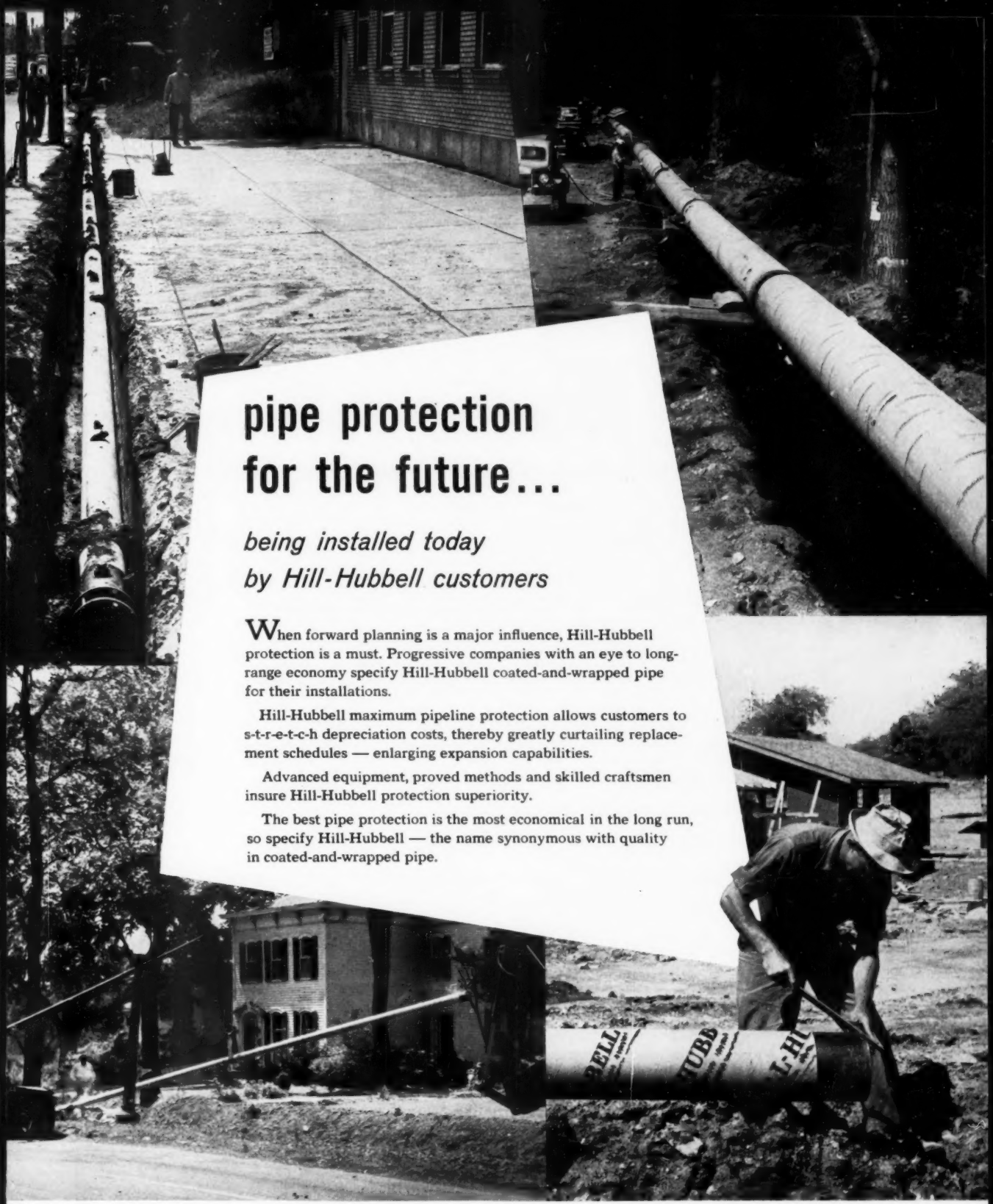
Engineers are taking advantage of the properties of versatile Geon polyvinyl material for this and many other types of applications. For information, write Dept. AA-6, B. F. Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

1¼" diameter pipe of Geon rigid vinyl is being installed by Illinois Power Company in gas lines leading to homes at Decatur, Illinois. In addition, ¾" vinyl pipe is being inserted in reamed-out 1¼" iron pipe under streets to avoid breaking the pavement to repair leaking gas lines. Kraloy Plastic Pipe Company, Los Angeles, California, makes the pipe. B.F.Goodrich Chemical Company supplies the Geon rigid vinyl.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON polyvinyl materials • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers



pipe protection for the future...

being installed today by Hill-Hubbell customers

When forward planning is a major influence, Hill-Hubbell protection is a must. Progressive companies with an eye to long-range economy specify Hill-Hubbell coated-and-wrapped pipe for their installations.

Hill-Hubbell maximum pipeline protection allows customers to s-t-r-e-t-c-h depreciation costs, thereby greatly curtailing replacement schedules — enlarging expansion capabilities.

Advanced equipment, proved methods and skilled craftsmen insure Hill-Hubbell protection superiority.

The best pipe protection is the most economical in the long run, so specify Hill-Hubbell — the name synonymous with quality in coated-and-wrapped pipe.

Specify Hill-Hubbell wrapped pipe on your next job . . .

HILL·HUBBELL

DIVISION OF GENERAL PACIFIC CORP.

3091 MAYFIELD RD. · CLEVELAND 18, OHIO · YELLOWSTONE 2-7535

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

new

Model Y High-Capacity Combination Gas Valve, Automatic Pilot, Oven Temperature Control, and Pilot Filter

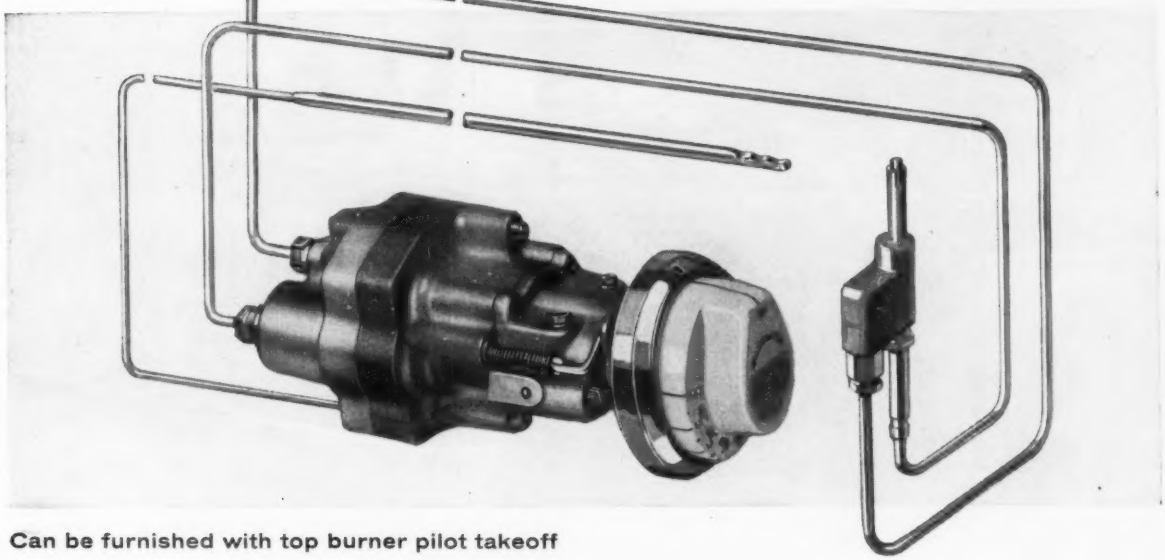
The new Wilcolator Model Y control is designed to be installed quickly and easily on any gas range . . . with a minimum number of extra fittings. At the same time, it is extremely easy to service because of its simplified construction and the fact that adjustments can be made from the front of the range. In all its features, the Model Y reflects Wilcolator's many years of experience in developing high-performance thermostatic controls that offer you important economies in installation and servicing. For complete information, request copy of new Bulletin 568.

CHECK THESE FEATURES

1. Smaller. Permits more compact manifold design.
2. Higher capacity than any comparable control. Assures less drop in oven burner system, faster preheating.
3. Flange bolts, lockwashers and flange gasket preassembled to save handling and stocking extra parts.
4. Electronically calibrated to eliminate all possibility of human error. Field adjustment rarely necessary.
5. Improved ambient temperature compensation assures constant oven heat.
6. Bypass, pilot and calibration adjustments made from front of range. Simplifies servicing.
7. Snap-on dials and bezels. No setscrews required.

FROM WILCOLATOR

- LOWER INSTALLED COST
- POSITIVE SAFETY SHUTOFF
- SMALLER, MORE COMPACT
- SIMPLER, EASIER TO SERVICE



Can be furnished with top burner pilot takeoff

Wilcolator Model Y Control

Temperature range:
200-550°F, plus broil

AGA rating, Btu/hr:
Manufactured gas—43,045
Natural gas—63,700
LP gas—136,000

New safety pilot Pilot burner of Wilcolator Model Y control incorporates thermocouple which produces electric current to hold main burner gas supply valve open. If pilot is extinguished, valve snaps closed, cutting off all gas to oven and pilot burners. Pilot can be lighted only when heat control is in Off position—a safeguard for the user.

Thermostats for Every Heating and Cooling Application

THE WILCOLATOR COMPANY
1001 NEWARK AVE., ELIZABETH, N. J.
In Canada: Wilcolator (Canada) Ltd.
221 Evans Ave., Toronto 14, Ont.

THE Wilcolator COMPANY

NOW FROM FORD
America's lowest-priced 4-wheel drive pickups
Six or V-8!

New Ford F-100 4-wheel drive Styleside pickup handles heavy loads and makes its own road.

ALL FORD-BUILT . . . FACTORY-ENGINEERED . . . FOR GREATER SAVINGS!

Go *Ford*-ward for 4-wheel drive performance at big Ford savings. New Ford 4 x 4 Pickups have the power and traction to go most anywhere. They're factory-engineered from the ground up for extra stamina, and all Ford-built with your choice of economical Short Stroke power—Six or V-8.

There's new versatility too, with two power take-off points in the transfer case to drive winches, saws, diggers, or other equipment. And there's new driving ease. You shift smoothly between 2- and 4-wheel direct drives while moving. Ford's *driverized* cab provides new riding comfort and modern styling.

Ford 4-wheel drive trucks are available in ½- and ¾-ton pickups, chassis-cabs and ¾-ton stake models. See your Ford Dealer . . . and save hundreds of dollars on America's lowest-priced 4 x 4's with Six or V-8 engine!

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!

GAS

JULY 1959

Production line methods applied to meter changes

By JAMES WEBB
Superintendent, Meter Bureau
Consolidated Edison Co. of New York

GAS exclusive

GAS meter maintenance is an operating function which should be considered and treated as routine. Routine operations are readily adaptable to a production line. Industry has long recognized that routine or repetitive operations are accomplished more efficiently and more economically when placed on a production line. Meter maintenance certainly fits in this category.

Many utility companies are now using, or are in the process of establishing, production line methods in their shops for repairing and testing meters. This can be accomplished because the products which are being processed are very similar. Ninety per cent of the meters in use today are small capacity domestic meters.

If meter repair shop operations can be performed satisfactorily by using the production line principle, why not apply the same principle to the periodic changing of meters. The work is repetitive and routine, and is an operation for continuous daily production.

Good production requires two important factors: a steady daily volume of work, and a constant complement of trained personnel to complete it.

Gas meter maintenance is one operation both in the shop and on the system which is applicable to mass production because of the quantity and similarity of the work. When the annual work load can be determined in advance there is no problem in setting up the required daily operations for both the meter repair shop and the system change group to keep changes on a continuing schedule.

Efficient production in the meter repair shop and on the system can be obtained only when a constant flow of meters passes through the shop each day. To maintain efficiency, it is necessary that the number of meters to be changed each year be broken down into constant daily quotas. Peak loads do not contribute to an efficient production operation. If the meters required to keep the shop on a smooth operating schedule are not forthcoming, it won't be long before the repair shop has lost its efficiency. Bottlenecks in production result from a lack of coordination between the meter repair shop and the system change group.

In many companies, the customer service department changes meters—usually using this work as a fill-in job. When an operation of this size and character is used for fill-in, production and economics are

neglected. This method of operating is reflected in the production and economics of the meter repair shop as well.

There are certain periods in the year when customer service work is at a minimum, and all available help is assigned to meter changing. In turn, this creates a peak load for the shop. If sufficient meters are not available, it may be necessary for the shop to work overtime, or to employ inexperienced temporary help. Neither method lends itself to production, or to economy or quality of work turned out.

To meet heavy demands without the use of overtime or additional temporary employees, a large stock of ready-for-use meters is required. The demand for large quantities for a short period may occur at any time, possibly several times a year. The shop is obligated to have these meters ready for use to meet these peak periods, creating a heavy temporary work load. Then, in a short time very few meters will be required, leaving the shop with only a handful of meters to process until the next peak arrives. This is an expensive way to operate for both shop and system.

To eliminate these costly operating conditions at the Consolidated Edison Co., the periodic changing of meters was transferred some years ago to the meter bureau, which also is responsible for the gas meter repair shop. The meter change operation also was centralized into one location, where formerly it was handled by numerous individual districts located in various parts of the city. There were many reasons for this decision. They can be summarized as follows:

1. Meter inventory can be decreased. It was necessary to carry an operating stock of ready-for-use meters in each district storeroom to maintain sufficient meters at all times, resulting in a large general stock. This is far from economical, and also calls for a larger than necessary capital investment in meters.

2. Meters were not changed at a uniform rate. Customer service operations received precedence, and the meter change operations were postponed awaiting free time. At other times, all personnel would be changing meters, creating a big demand during a short time, and increasing the work load in the meter repair shop far beyond the schedule for normal everyday procedure.

Fiber carrying cases for 5 Lt and Class 50 meters which are used on 1-ton, 1-man panel trucks. Trucks hold three carriers.

3. Transportation to deliver meters from the shop to the individual districts, and to pick up and return to the shop the meters which were removed, was very costly. This also required extra handling, exposing the meters to damage. It should be unnecessary to move meters from one location to another, and re-load them on customer service trucks to complete a change-out. This also applies to meters being returned to the shop for reconditioning.

4. The daily routing of meter changes from numerous locations is not satisfactory because of the variety of work in each district. As previously mentioned, customer service operations which are not routine receive preference; consequently, these are not adaptable to the same routine as meter changes. If a customer serviceman has a few meters to change in the vicinity of his customer service call, he might fill in his time doing them. After a period of time with this type operation, the meter changes remaining to be completed will be widely scattered—which increases costs. To change meters on a fill-in or "when you have time" procedure, meters are transported in trucks for a much longer time than is recognized as good practice.

5. "No access" cases always increase when meters are changed as a secondary operation. The serviceman does not have time to make or keep appointments, or follow up on a job. Failing to keep an apppointment with a customer causes annoyance, and does nothing to create good customer relationship.

6. Peak work loads in the meter shop always occur when meters are changed as a secondary operation.

7. Rapid processing of meter orders after they are changed is very important. Meter records and periodic scheduling files should be maintained by the meter bureau, of which the meter repair shop and the system meter change group are a part. When meters are changed by meter bureau personnel, the meter change orders are in the hands of the clerical section the next morning. This enables the clerical group to process all orders at once, without peak loads, and to advise the commercial or accounting departments of the meter change and the readings of the old and new meter. This is important when many meters are changed daily. When the meter bureau makes the changes, the information is passed to the appropriate clerical group immediately; when meters are changed by other groups operating from individual locations, there is always a delay in getting the meter orders to the processing clerks.

The state of New York requires gas companies to change meters every seven years. Consolidated Edison changes approximately 200,000 a year. The repair shop routine is established to supply sufficient meters each day for scheduled system changes. With a definite schedule of daily output, the meter shop can produce repaired meters consistently, and simultaneously maintain quality workmanship.

Changing 200,000 meters per year requires the handling of 1700 meters per day, including the meter to be installed and the meter which has been removed.

Left and below: Exterior and interior of periodic change meter truck. Capacity: 175 5-Lt meters or 230 Class 50 meters.

• Advantages of operation

The disadvantages of periodic meter changes being made by a group other than the meter repair shop have been discussed briefly. Now, to see the advantages of having meter changes under the same supervision as the meter shop, let's take a look at the present practices followed by Consolidated Edison Co.

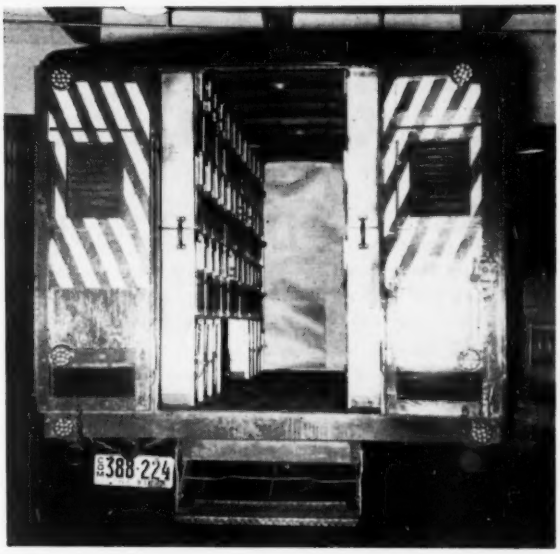
Orders for changing all meters scheduled for replacement in any one year are issued at the same time. The entire year's work is routed before any orders are released for completion by the serviceman. This eliminates a revisit to any area in the same year for a periodic meter change. Areas are visited only once a year unless it is necessary to keep an appointment on "no access" cases at a later date.

Periodic meter changes are first segregated into boroughs and broken down into areas which follow consecutively until the end of the year. For example, on Manhattan Island periodic meter changing is started in the Inwood section, which is the most northerly point on the west side. The island is divided into two parts, the east and the west side, by a line approximating Fifth Ave. Work continues down the west side of Manhattan to the Battery, then up the east side to Harlem, which is the northerly point on the east side. Sufficient personnel is assigned to Manhattan island to make certain all changes are completed by the end of the year.

The other boroughs are worked in the same manner. In some instances, due to parkways, thruways, railroads, etc., it may be necessary to work certain areas independent of the borough as a whole to improve routing.

Trucks carrying 175 five-light meters are used for scheduled periodic change work. The meters are carried in individual compartments in the trucks. These trucks are loaded at night at the meter shop so they will be ready to leave for field locations the next morning. Trucks depart from the shop in time to reach the work area before the starting time for the servicemen. Servicemen report to a designated location each morning, where they receive orders from their foreman. The location changes as the work progresses in the section.

Meters are delivered by the driver to the sidewalk



at the building where changes are scheduled to be made. Servicemen follow the trucks on foot, and make the changes. Meters which have been removed are left on the sidewalk at the building line to be picked up later in the day by the truck. The driver who delivers the meters starts work one hour before the regular crew, and stops one hour earlier. A serviceman who starts one hour later than the regular crew picks up the removed meters, and delivers them to the repair shop with the completed meter orders. During the day, between the delivery and pick up of the meters, the driver keeps meter-changing appointments which were made the day before by a serviceman or the crew foreman.

In addition to the large truck which is assigned to a group with the foreman, one or more 1-ton panel trucks are used for "specials" such as appointments and "other reason changes." As the periodic change group moves from one area to another, the small truck changes meters on special appointments which may have been made by the foreman in the section just completed. It is the responsibility of the foreman of each group to keep the "no access" cases to

a minimum. With couples going to work, it is necessary to make many calls after 6 p.m. or before 8 a.m. Each group has a serviceman assigned to an out-of-hours work shift, such as 7 a.m. to 3 p.m. and 2 p.m. to 10 p.m. A schedule of these hours enables the foreman to keep "no access" cases at a minimum. In a city the size of New York, there are many reasons why access cannot be obtained — buildings boarded up awaiting demolition, customers away from home for a long period, inability to locate "floating building superintendents" who have the keys to the meter rooms. In some instances, the customer's meter is located in another customer's apartment, requiring access to two apartments at the same time.

If a serviceman cannot gain access after several out-of-hours calls, a contact is made by letter or telephone, requesting an appointment. These appointments are kept by a serviceman working alone.

In addition to the periodic replacement operation, the meter bureau changes meters for complaint tests, referee tests, noise, non-registering, and for other reasons which are not emergencies. Leaking meters and those which do not pass gas are changed by the emergency group.

• Savings on tools

In an organization where many employees are assigned to work on varied customer service operations, including meter changes, during any work day, it is a must that the serviceman be supplied with all the tools and safety equipment that any occasion may demand. Purchase and maintenance of proper tools to enable a serviceman to do a quality job is costly, and involves keeping a large inventory of replacement tools.

There are considerable savings to be obtained in tools and equipment when employees are assigned to identical work each day. If all personnel work on meter changes part of the day, and service appliances for the balance of the work shift, the entire group will require a full complement of tools at all times.

The serviceman of today requires an average of about 60 different tools for his diversified work. There are many days that the majority of these tools are not needed; nevertheless, he must have them available. When servicemen are assigned meter changes only, a simplified tool kit weighing 5 lb 10 oz can be used. Aluminum step ladders (4 ft in height) are carried in the trucks for use when needed.

The simplified tool kit for the serviceman who changes small capacity meters consists of: tool bag; 8-in. wrench; 10-in. wrench; 1.5-in. screwdriver; leak detector brush and plastic bottle; two carrying straps; flashlight; electrical shunt wire; aluminum case for meter orders; match holder; and a pair of gloves.

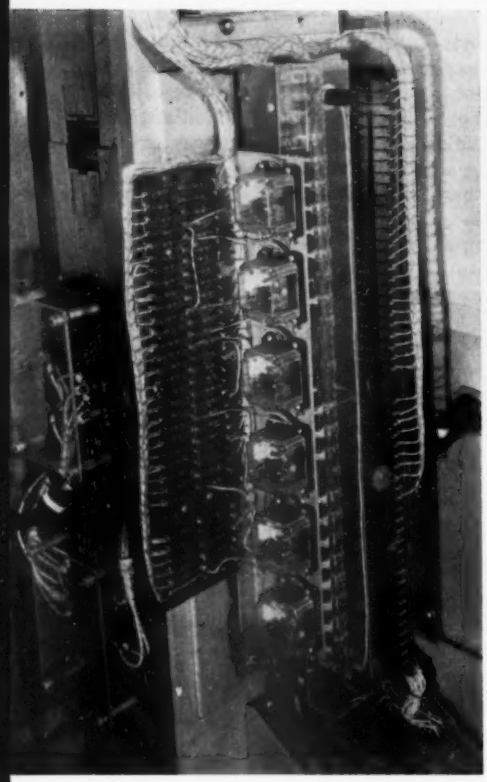
• Meter handling

Any discussion on meters is not complete unless mention is made of meter handling. It is the responsibility of management to provide the best equipment available, and to insist on a continuing educational program on the proper handling of meters.

The gas industry has some 32 million customers. Each one has a meter. This represents a tremendous investment to the companies, and presents the meterman with an important maintenance responsibility. Handling of meters is a major part of meter maintenance, and should receive as much attention as the actual repair and testing.

In summary, the advantages of changing meters as a primary operation, and not on a "when we have free time" basis, are economic. The advantages are: improved daily production for shop, system and clerical groups; less operating stock required; less handling of meters; simplified records; savings in transportation costs; customers are aware that meters are being changed in their area, and wait for servicemen; no-access cases kept to a minimum. ■

Simplified tool kit for changing small capacity meters consists of two wrenches, a screwdriver, leak detector brush and plastic bottle, two carrying straps, flashlight, electrical shunt wire, aluminum case for meter orders, match holder, and a pair of gloves.



Evaluating company needs for electronic data processing

By H. H. BOCKSTEGE JR. and W. M. KING JR.

Consultants, Commonwealth Services Inc.

PART 2 OF A TWO-PART ARTICLE

CAN electronic data processing cut costs and increase a company's profits? If so, what sort of EDP system would be suitable and economically feasible for my company? These are the questions many businessmen have been asking since the first large scale electronic computer for processing business data was delivered in January 1954.

There is no doubt that EDP systems offer many companies at least a partial solution to the problems of increasing paper work in the face of rising clerical costs and a shortage of suitable personnel. In addition, electronic equipment can also help: (1) reduce capital requirements, by controlling required investment in inventory, freeing capital for other purposes; (2) improve customer service; (3) secure accounting, engineering and statistical data in time to be of maximum usefulness; (4) force personnel compliance with standard procedures, eliminating the high degree of exceptions to prescribed routines always found in manual data handling methods; and (5) the simple fact that EDP requires scheduling, down to the most minute clerical operation, means that a day's work must be done in a day's time. It is the tool that makes *supervisors* out of supervisors and *clerks* out of clerks.

If all these benefits are available from EDP, why do we hear conflicting opinions from those who have installed electronic equipment? Those companies reporting unsatisfactory experiences may not have taken sufficient time to evaluate their specific needs, and to design a data processing system to fill these needs.

Electronic data processing is still so new and revolutionary in concept that very few people understand the maze of equipment now made and the most efficient ways of using this equipment, or "hardware," as it has come to be known. It is increasingly thought that computers and other new machines will revolutionize office procedures and organization structures in the next few decades. Thus, companies are interested in the subject and wish to know as much as possible about EDP's future in their operations.

This rush into a new field makes it all the more important that those considering EDP take sufficient time to study their existing procedures in the light of available equipment. Experience proves that companies who enter the field with proper caution inevitably save money by steering clear of unnecessary

machines, and avoid employee morale problems and inefficient procedures that do not give the desired results.

Many companies cannot afford and do not need EDP systems. However, every company should periodically review its data processing methods. Properly done, such an investigation gives management a chance to up-date and improve present procedures. Many companies don't need expensive equipment or additional personnel. Their big need is to revitalize their present set-up by making it more modern, efficient and effective.

Too often a system or procedure was designed in years when the company was relatively small. As the company grew, the same systems and procedures were continued; consequently, an antiquated system was upgraded and continued without consideration for newer needs. The old slogan "It's served its purpose for 20 years and we see no reason for change now," can be an expensive proposition. With this attitude and approach, there is usually much duplication in manpower and paper work. Many gas companies still keep identical service location files in both their accounting and operations departments. One file for use by both departments can be developed with obvious savings. An up-to-date data processing system will also help eliminate another costly situation: the preparation of reports for which the passage of time and changes in supervision have eliminated the need.

The many advantages of an electronic data processing feasibility study seem fairly obvious. More efficient and profitable future operations are a reasonable expectation, whether the study points up the need for EDP or simply results in better systems of handling paper work without a completely new operation. How then, should a company approach such a feasibility study?

• The feasibility study

Every company situation is different; however, certain procedures are common to any well-rounded EDP feasibility study. Formation of a long-range study committee is the initial step.

The committee should be under the direction of a strong member of management, known for his analytical skills, tact and diplomacy. Ideally he would be a younger man with complete access to top management. His job should be devoted to steering the committee along the "integrated management" approach to automation. Without strong leadership, the committee may see EDP as a high-priced bookkeeping tool instead of as a revolutionary new approach to management.

Number two man on the committee should be suited to take direct charge of the new electronic system, if it is adopted. Previous experience is not as important in his case as aptitude and proven management abilities. Other members of the committee should represent the principal departments to be surveyed.

Frequently the needed talent exists in the organization, but is too busy at essential work to be freed to do other jobs. In such cases, the outside consultant becomes a valuable temporary supplement to the existing staff.

Independent consultants offer three distinct aids to company specialists: (1) a broader knowledge of all manufacturers' hardware or equipment, (2) an independent viewpoint, (3) a broad range of experience with systems adopted by companies with similar problems. This outside consultant should in no way replace the company specialist, but should rather assist the committee in using information and offer technical help not available within the company.

From the company's standpoint, its real "expert" is the man whose daily activity within the company makes him thoroughly familiar with its problems, needs, methods and policies. Unthinking use of outside assistance generally takes its toll when the outside expert is employed without teaming him with a company expert. Together with the feasibility committee, the outsider endeavors to come up with solutions to specific problems that may have been perplexing management for months or even years. His judgment is based on wide experience and nicely complements that of the company's specialists, whose thinking is based on an intimate knowledge of all factors involved. In the development of any new data processing system, it is of the utmost importance that the consultant work closely with company personnel.

The EDP study committee should approach its job along the following lines:

I. Review of present procedure, job by job and function by function;

II. Definition of areas where EDP can make improvements and development of tentative new procedures for same;

III. Discussion of proposed procedures and requirements with various equipment manufacturers;

IV. Calculation of possible savings and estimate of other benefits;

V. Compilation of findings for presentation to management.

I. Review Present Procedures. There are three parts to paper-work programs which must be thoroughly explored before any type of data processing system is designed and installed. Since they are basic to any data processing program, each must be thoroughly understood and completely investigated.

1. Every step in the procedures bearing on company paper-work routines should be analyzed in detail and recorded, from the raw state through the processing and its various end uses. It is necessary to evaluate the purposes for such data and to ascertain that the data is actually what it purports to be and is being used as originally planned. Failure to follow through in checking a system will lead to the wasteful use of data in ways which were never intended.

2. A thorough investigation should be made of all equipment, devices, machines and forms involved in recording data at every point in the procedure where a record is created or where additional information is placed on an already existing record.

3. The planning, layout and construction of records should be thoroughly investigated to provide maximum efficiency, accuracy and economy in the processing steps in which it will be used.

II. Define Needed Changes. Once it has compiled a complete picture of existing procedures, the committee is ready to analyze the routines which it may wish to convert to more efficient machine data processing or to an electronic installation. Where to start? Generally, the order of approach should be progressively from the areas of greatest need and prospect for improvement to those of less need and prospect for improvement. In this approach, a logical starting area is that in which there are found, in combination, the highest cost and the greatest number of detailed processing operations of the present system. In other words, first analyze the routines known to be inefficient or otherwise presently unsatisfactory.

Analysis is essentially nothing more than ascertaining, step by step, how something is being done, then determining, step by step, how it may otherwise be done. The question of need also enters into the matter. Analysis may reveal that data for which a need no longer exists continue to be compiled or, conversely, that data which might be highly significant have never been developed. Among the useful aids in this analysis are: flow charts, data on work loads, time schedules, manuals of procedures, discussions with officers, department heads or supervisors receiving reports or data as to the usefulness of such data or suggestions for improved data, staff conferences, departmental meetings or any direct contact means with employees as to "their" ideas for improvements. As no one person is capable of knowing all the problems and their solutions, the people that are directly concerned are usually the best source for initiating an analysis.

III. Talk With Equipment Manufacturers. Equipment manufacturers are happy to furnish information regarding their own machines and their recommended applications. A comprehensive study will no doubt indicate that a company's best interests may be served by using a combination of different manufacturers' equipment. Once the complete system has been laid out, a detailed report on the necessary computer and/or other equipment requirements is submitted to various manufacturers for bids or production. Sometimes it may be found that a manufacturer does not produce equipment that will fulfill all of the requirements of a proposed system. However, with the aid of the manufacturers, such a piece of equipment can be tailored to the designed system, if it can be proven that the standard equipment will not suffice. In fact, most manufacturers are anxious to work with the companies on their application problems because, through such association, the manufacturers are able to improve their own products.

Hardware for an EDP system falls into four categories: computing equipment, auxiliary devices, input equipment, and output equipment. In laying out a system, all equipment must be evaluated as to cost, capacity of input and output, types of computations, accuracy and scheduling requirements. Personnel and their training, space requirements, power facilities, areas for expansion and improvements in technological changes must be considered, in addition to the hardware.

IV. Weigh Benefits. Installation of EDP will decrease costs in companies of rapid growth. Companies with little growth potential should not expect great savings from the installation of mechanized procedures, although a periodic review of existing systems is always a valuable aid to efficient management, and slow growth companies will benefit from such a review of present procedures.

Where applicable to a company's needs, EDP can record revenue and expenses, and strictly as a by-product, furnish a more complete analysis of revenue and expenses both on a current and a comparative basis. More efficient record keeping for materials and supplies is an area in which large savings can be realized. By recording the quantity on all issues and the quantity and money on all receipts, all pricing for distribution can be done electronically with great speed and complete accuracy. The same information, in different sequence, serves as a perpetual inventory. Capital tied up in inventories can be decreased by more comprehensive and up-to-the-minute stock balance reports.

The information derived from EDP puts management much more in control of finances than do manual or key driven systems, though the value of this control must always be balanced against relative costs before making final recommendations.

EDP lends itself to centralized purchasing, telling when to order and in what volumes, thus affording the savings represented in volume buying. On record is a gas distribution company of 250,000 meters, in a decentralized operation, which cut its annual average inventory from $3.5 million to $2 million after the installation of EDP. At current interest rates, the savings represented annually are sizable. Next to customer billing and accounting, inventory control is the largest area of savings from EDP. It is more true in a decentralized operation with a number of storerooms than in a self-contained operation.

V. Presenting Findings. When the feasibility study is completed, a comprehensive report of the findings should be presented to management at a conference attended by the entire feasibility committee, as well as by senior management. The entire committee should be present which will allow for answering any questions that may arise, as no single member of the group can answer all questions on a project of this scope. The written presentation should show current costs, and any tangible and intangible savings represented in the proposed system. It is most important that the committee have all the answers to questions of organization, as well as to those of actual data handling. The committee must remember the human elements involved in acceptance of any idea or plan. It must stress the fact that EDP tends to evaluate the status of personnel and enable them to do more for both the company and themselves.

• EDP installation steps

Once electronic data processing is given the green light by management and the feasibility committee, it is generally necessary to: (A) analyze the personnel relations aspects of the new operation and plan a comprehensive indoctrination program for all company personnel; (B) select and order the proper equip-

ment; (C) train personnel in computer programming techniques and, at the same time, write programs for the initial applications; (D) test computer programs for possible trouble spots; (E) provide the necessary physical requirements for the equipment; (F) select a staff to run the system and, in the case of purchased equipment, provide proper maintenance personnel; (G) complete the indoctrination of other employees in the new system and its procedures; and (H) plan a smooth and effective changeover when the new equipment is installed. Again it should be stressed that these requirements constitute a long and arduous undertaking.

A. As with the feasibility study, the initial installation and operation of an electronic data processing system must be approached carefully with due regard for the completely new concepts involved in automated business systems. EDP possesses the potential to revolutionize modern business procedures. It should not be considered as just another group of new office machines. In addition to its efficient handling of more routine data processing jobs, it can give management heretofore unavailable information for correctly making important decisions.

Such implications call for careful study and analysis by social scientists and industrial relations people. Every member of a company staff will be affected in some way by future uses of the electronic computer. Many department functions will be changed, along with job descriptions and personnel requirements. With this in mind, the human relations problems of the new installation should be given primary consideration before definite steps are taken to install an EDP installation.

B. The company committee and its independent consultant should discuss projected plans with various equipment manufacturers. Data processing does not depend on the use of a specific type of computer or machine, but on the use of a group of machines designed to be used together. It is quite possible for an installation to use equipment of several manufacturers for maximum efficiency in handling its specialized data processing needs.

C. The electronic wizards will do only what they are told to do. At this point, company personnel must begin their training in the handling of the new equipment. Written programs for initial installations must be prepared. These programs must contain step-by-step instructions on what to do and how to handle all problems, as well as various exceptions to normal routines.

Programs are created by the still essential human beings who will be in charge of the machines. Staffing and programming a single application may require thousands of man-hours, but the program, once it is made up, can be used as long as the application remains a part of over-all company procedure. Everything should be thought out in complete detail. The necessity of minute analyses and detailed programs usually makes it preferable to limit the number of applications to be placed initially under an electronic system. The company should have a comprehensive plan for every feasible use of this expensive equipment, but it should be instituted slowly to allow the development of both staff skills and understanding.

Transcribing the backlog of carry-forward data into the system will be a major task in itself. Problems of audit must be resolved. Changeover to the system will be gradual, as successive applications are planned and programmed on the above basis.

D. Test Computer Programs for Possible Trouble Spots. After the program has been organized in line with the equipment selected, the entire setup should be tested; usually at the equipment manufacturer's plant. These tests will eliminate many problems that could come up later since the manufacturer's specialists from throughout his plant can be called into action on any situation that may arise during the test. It also gives those in charge of the program an opportunity to iron out their own thinking on any procedures, enabling installation on the company site with a minimum of uncertainty.

E. Provide the Necessary Physical Requirements for Electronic Equipment. This entry into the electronic age will call for a number of special considerations on the company premises. Space requirements must be met and a careful study should be made to provide adequate and properly stressed floor space. Necessary voltage and air conditioning requirements must also be considered.

F. At this point the staff should be completed. Any necessary additional personnel should be recruited and trained. In the case of purchased equipment, proper maintenance personnel must also be provided.

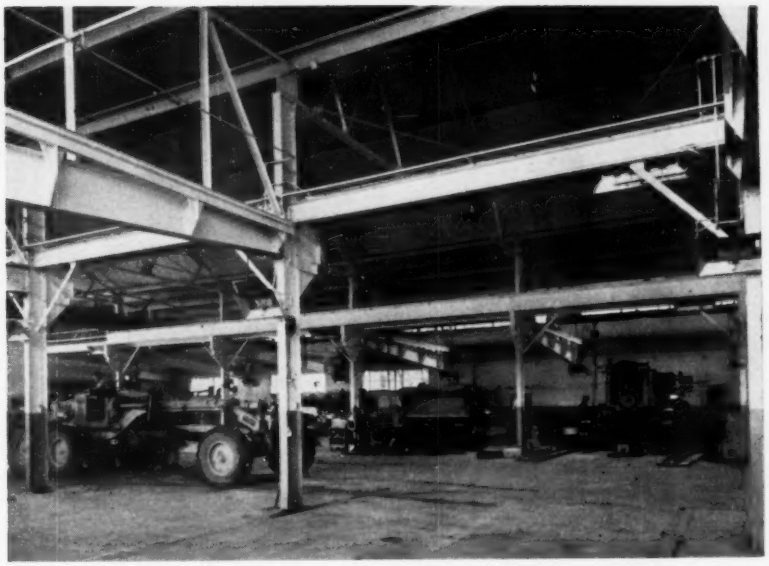
Wherever possible, the entire staff should be chosen from existing personnel. It should be remembered that, with the development of proper systems and the installation of the proper equipment, training of any needed personnel is relatively simple. The data processing consultant should be able to recommend proper maintenance procedures.

G. Complete the Indoctrination of All Employees on the New Systems and Procedures. A continuing information program will help assure a smooth transition to the new system. The complete story of electronic data processing should be explained to personnel in the simplest form available. For instance, many companies have found that booklets, containing cartoons and simple drawings with explanations, are the most feasible way of accomplishing this purpose.

H. Plan a Smooth and Effective Changeover When the New Equipment is Installed. If thorough attention has been given to the preceding steps, there should be little or no trouble changing over to the new system. It cannot be overemphasized that one of the dangers of any installation is the pressure from management for an accelerated changeover, with all possible applications being changed over within a short period of time. To avoid such dangers, the changeover should be a gradual process, with each application being performed in a smooth and orderly manner before any additional application is considered. True, such procedure will involve more time than management may feel is necessary, but the time spent on the changeover will insure a smooth running installation, rather than an unsatisfactory experience from accelerated changeover. ■

• **A case history of an infra-red radiant heat installation**

Heating an 'unheatable' building



Gas-fired infra-red heaters make it possible to use this hard-to-heat building as a construction equipment maintenance shop. Heaters generate heat where it's needed, keep floor, equipment and tools warm despite high air infiltration, frequent door opening.

WHEN Whayne Supply Co., a construction equipment distributor in Louisville, Ky., took over a display building as a repair shop in Kentucky's old State Fair Grounds, they anticipated "impossible" heating problems as the one disadvantage in the acquisition of long, broad, well-lit crane bays that would accommodate huge construction equipment undergoing repairs. The company considered using only portable heaters of the type used at construction sites to provide limited spot heating. Because of a new type of heating with infra-red rays, however, heating turned out to be a simple problem and far more economical than anyone anticipated.

The building had never been heated before Whayne acquired it as it was used only during the Kentucky State Fair in September. Now, 14,000 sq ft of the 16,000 sq ft structure are heated by individual gas-fired infra-red heat generators suspended overhead and providing direct heat where it is needed. (The remaining 2000 sq ft are completely enclosed areas heated by forced air furnaces.) The company maintains a 65 deg. temperature in the building at a cost of only $00.242 per day per deg. F below 65.

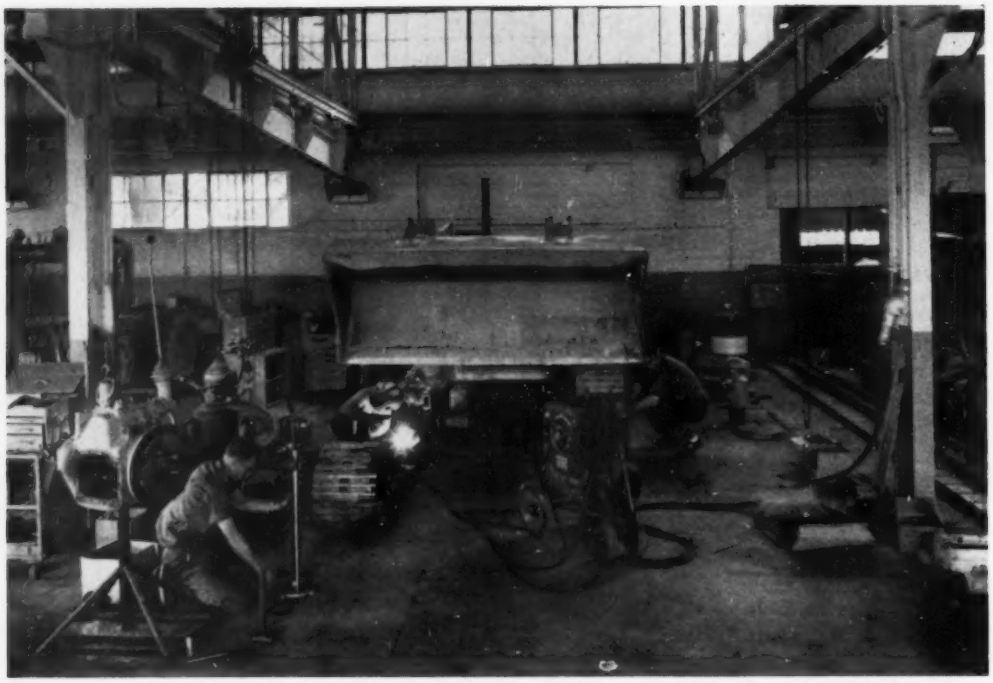
Whayne's heating system provides comfortable working conditions in cold weather despite frequent door openings as machinery is moved in and out and despite the fact that the building was not designed to be heated. The 100 × 160 ft building has concrete walls, a steel roof, and a 4-ft ribbon of windows, totaling over 1600 sq ft of glass area, around the top. The center bay, 40 ft wide, is 20 ft high and the two-side bay, 30 ft wide, is 12 ft high.

• Small temperature differential

The high center bay, the large window area and high air infiltration make the building particularly difficult to heat by conventional methods. Heat lost from warmer air in the upper regions through the windows and around window frames would be excessive and would have to be replaced continuously to keep lower areas warm. Using radiant heat from infra-red generators minimizes these losses. The radiant heat warms the floor first and the upper regions are never more than 2 to 5 deg. warmer than air at the floor level.

Frequent door openings may remove the warmed air from the space but all the heat is not dissipated and workers don't suffer from the sudden drafts. The concrete floor continues to re-radiate warmth and since workers receive heat more from the radiant heaters and the floors than from the air itself, cold drafts don't bother them.

In an experiment made by the firm that installed the system, Olson Infra-Red Heating Inc., doors at both ends of the center bay were opened until a thermometer held near the floor dropped from 64 to 58 deg. F. This took 15 minutes. When the doors were closed, the 64-deg. temperature was regained



Generators radiate over entire floor surface, providing heat directly. High temperature combustion (1600 deg F) produces rays in lengths readily absorbed by most materials. Concrete floors act as secondary radiators, keeping men warm despite cold air currents.

in one minute. Outside temperature during the test was 21 deg.

• Heater design

The ability of the infra-red units to convert fuel into usable energy is due to the unique design of the burner element. It is a ceramic element invented by German scientist Guenther Schwank and developed into practical heating units in this country by Perfection Industries, a division of Hupp Corp. In operation, the ceramic surface, at a temperature of 1600 deg. F, generates infra-red energy in the range of 1.5 to 6 microns. Concrete and other common substances readily absorb this type of infra-red.

In the operation of the heaters, air drawn from the atmosphere is mixed with gas in a chamber behind the ceramic. The mixture is passed through hundreds of holes (200 per sq in.) in the face of the ceramic where it burns as a separate flame at each hole. The rear surface of the ceramic never exceeds 400 deg. F. Combustion is completed within one-eighth in. of the ceramic face.

• 100 per cent efficiency

The Perfection-Schwank generators convert 100 per cent of the fuel's energy to usable heat. About 60 per cent is infra-red energy. The remainder of the heat is embodied in the combustion gases (carbon dioxide and water vapor) which is diffused throughout the space. No direct ventilation is required for combustion gases when the generators are installed in well ventilated spaces. Units are approved by AGA and Underwriters' Laboratories for use in non- and semi-hazardous locations. Combustion gases contain a lower percentage of carbon monoxide than those emitted by kitchen ranges. Infiltration and frequent door openings provide more than enough air to maintain a healthy atmosphere in Whayne's building. Exhaust gases from equipment engines are ducted outside.

There are 24 heaters each with two rayheads and eight with four rayheads in Whayne's building. Each rayhead generates 12,000 Btuh, equivalent to 4.7 hp in energy. Each rayhead radiates over approximately 54 sq ft. Units are positioned for even distribution of heat. They are mounted below cranes to avoid interference with them or overheating of crane mechanisms. They are positioned at a 20 deg. angle to avoid concentration of heat that would make workers directly under them uncomfortable.

• Control system

The 960,000 Btuh system was designed to raise indoor temperature to 65 deg. at 20 deg. outdoor temperatures. A thermostat, mounted 4 ft high on a wall at the center of the length of the building, and a solenoid valve at each heater control the system. When temperature drops below the 65 deg. setting, the solenoid valves actuate to open the supply line to each heater. A pilot light ignites the flame. The solenoid valve is also controlled by a current generated in a thermocouple under the pilot. Should the pilot go out, the valve closes to prevent free escape of gas. The solenoid valves operate

from a 110-v line. The only other connection to the unit is the gas line. They are suspended with simple angle iron mountings.

The units operate on natural gas supplied by the local utility. Because Whayne has portable heaters available for construction site work, management decided not to install a standby L. P. gas system for use during the few days when severe weather forced the utility to limit industrial gas usage. (Perfection- Schwank units are made for either line or L. P. gas. The line gas heater may be used for L. P. gas if pressure is increased sufficiently. An L. P. standby system requires only a supply tank for the liquid gas and appropriate pressure adjusting and valving mechanisms.)

There were only four days during the past winter when Whayne was required to use portable heaters.

• Design temperature

When the Perfection-Schwank units are used in weather colder than the design temperature of the installation, indoor temperature cannot be maintained at the 65 deg. thermostat setting. For example, the units could be expected to maintain temperature of 45 deg. in zero weather. (In actual practice, variables such as wind and door openings have permitted a temperature greater than the 45 deg. design temperature.) However, the lower temperature is not a good measure of worker comfort. The floor, tools and machines remain warm to the touch because of the direct radiation from the heaters. Since personnel receive heat more from the floor and the heaters than from the air itself, they can be comfortable at low temperatures. The situation is comparable to that of a man who builds a bonfire in freezing weather. He is warm although the air remains cold.

Because radiant heat can be used directly in this way, Whayne decided that a 45 deg. temperature rise would be sufficient. A 0 to 65 deg. temperature rise would have required an approximately 1,330,000 Btu system, 35 per cent larger than the system installed.

• Efficiency

The 100 per cent combustion efficiency of the Perfection-Schwank units without loss in a transmission medium is not the only reason for their economical operation. The lack of forced convection and air circulation means that heat losses through exposed walls are reduced. Losses are not increased because of temperature differential between upper and lower levels of air.

There is also another economical advantage in that heaters are producing to capacity almost as soon as they are turned on. Workers benefit immediately from the radiant heat produced. There need be no warm-up period in the morning.

Considering all factors, Whayne estimates that the system provides heat at a greater degree of efficiency in respect to worker comfort at 30 per cent less cost than any other system. Although Whayne's problem was to find a system that would provide consistent, reliable heat under difficult conditions, the company also figures that it saved money in the process. Whayne's heating cost for the 1957-1958 season, at $00.566 per Mcf of natural gas, was $820.07 for a 235-day season of 3383 degree days. The building was heated 24 hours per day.

Cost per sq ft for the season was $0.056. ■

Infra-red dealer conducts experiment to determine effect of frequent door openings on inside temperature. Opening doors at both ends of building in 21-deg. weather reduced temperature from 64 to 58 deg. in 15 minutes. Higher temperature was restored in one minute after doors were closed.

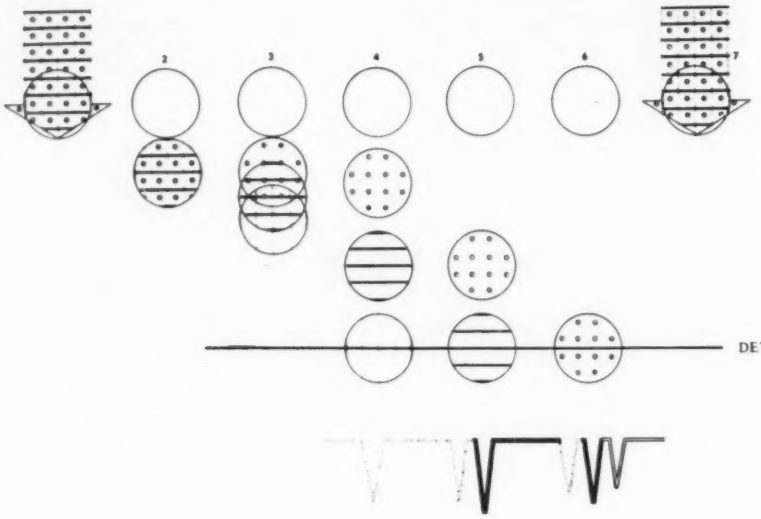


Fig. 5. Diagram shows principles of gas chromatography analyses.

Stream analyzers

By D. J. FRAADE*, Consolidated Electrodynamics Corp., Pasadena, Calif.

ONE of the most significant steps in the development of continuous process stream analyzers has been the advent of gas chromatography. In the relatively few years since this instrument made an appearance on the processing scene, the adaptation of the technique and theory of operation have been incorporated into acceptable plant-type instruments.

Gas chromatography separates components in a gas stream by driving it through an adsorption column with a carrier gas, usually helium. The length of retention time within the column is a function of these components' various affinities for the column packing. They finally exit from the column in approximately the same order as their coefficient of thermal conductivity. The gases are detected by a hot wire formant or thermistor. The resulting millivolt signal is fed to a standard potentiometric strip chart recorder where the millivolt signal drives the recorder pen to present a component chromatogram or peak height for each signal. *Fig. 5* diagrams this principle.

Having such a quick, repetitive and automatic method of gas analysis has been a great advantage to processors. These instruments lend themselves to automatic programming, so that operators may look at various streams in and around a processing area. All results reported indicate these instruments have a direct and favorable payout in terms of the capital investment.

One Gulf coast operator has reported an increase in propane recovery as a result of installing a process type chromatograph. He states there was an increase of about $10,000 in revenue in two months after a chromatograph was installed and put into operation. The resulting profits occurred from the increase in yield and the pinpointing of what had been troublesome spots in the process operation.

GAS exclusive

Fig. 6. Laboratory setup for feeding individual components into mass spectrometer for complete component scanning.

a continuous approach to improving control

Part 2 of a 2-part article

There is a strong movement afoot by various local associations of gas producers to supplant existing test methods by gas chromatography as a basis for royalty payments at the lease. These instruments may be installed locally in the area. Their charts are produced as a result of non-human intervention, thereby eliminating all inherent errors due to wet or dry chemical laboratory bench methods.

The extreme flexibility and universality of the chromatographic principle of analysis means that such an approach is applicable to practically every stream in every application where natural gas is being transmitted, stored or processed. It has been mistakenly called the "poor men's spectrometer." This is far from the case. Chromatography has proved to be a successful adjunct to the mass spectrometric type of analysis. Where the size of the operation warrants it, the mass spectrometer is used in conjunction with

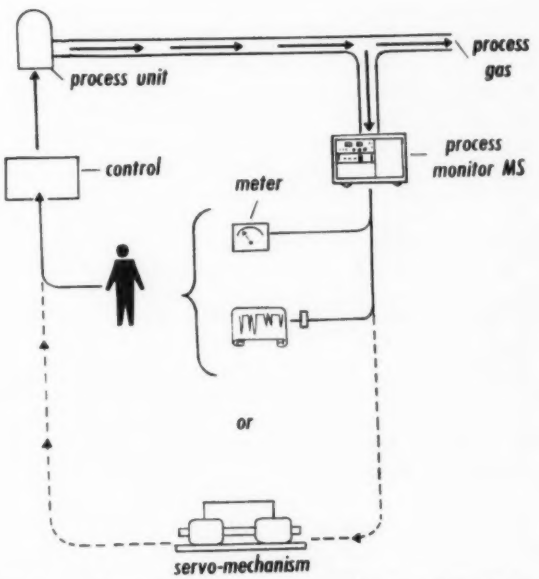


Fig. 7. Installation of mass spectrometer makes it an integral part of process stream.

• Mr. Fraade is supervisor, application engineering, analytical and control instruments at CEC.

gas chromatographs as a final complete and detailed analyzer.

In practice, the various single components, as they emerge from the chromatographic analyzing column, are collected individually. In this fashion they are fed into the mass spectrometer for a complete component scanning. *Fig. 6* shows a laboratory setup.

• Mass spectrometer

The mass spectrometer in its original concept was meant to be the complete analyzer for large control laboratory installations. Perhaps the most versatile tool of all stream analyzers, the mass spectrometer has been a major scientific contribution of our time.

The outstanding advantage of mass spectrometry is its ability to analyze gases and liquids more rapidly than other methods. The mass spectrometer is not limited to particular compounds or any particular concentration range. Operation is simple. Multicomponent samples of varied types can be analyzed accurately and rapidly by non-professional personnel. In plant control and research laboratories the mass spectrometer is employed to analyze individual samples as small as 0.1 standard cc of gas or 0.001 cc of liquid.

As a process monitor, the mass spectrometer is located in the plant proper. The sample is led in directly from the process stream. *Fig. 7* shows how such an installation becomes an integral part of the process. Deviations from optimum plant operation are reflected almost instantly as a recorded change in sample composition. Process control, based on the accurate and continuous analysis provided by the mass spectrometer, results in improved product quality, increased process yield, and more economic plant operation.

All mass spectrometer analysis is accomplished by bombarding an extremely small amount of sample vapor with an electron beam. The resulting charged molecular fragments or ions are then sorted electromagnetically and the relative abundance of ions appears as an electrical output from the analyzer. Recording this output provides a means of qualitative and quantitative analysis.

Fig. 8 is a schematic presentation of operation. The sample gas is fed into the instrument through the connection on the right-hand side. It passes through the inlet block and is then vented. Only a small portion (less than 1 cc per second) of the gas flowing through the inlet block is drawn in through the capillary inlet tube. Design of the capillary inlet tube and pumping speed of the inlet forepump are such that a 1 mm Hg pressure is maintained above the molecular leak at all times. Only that portion of the

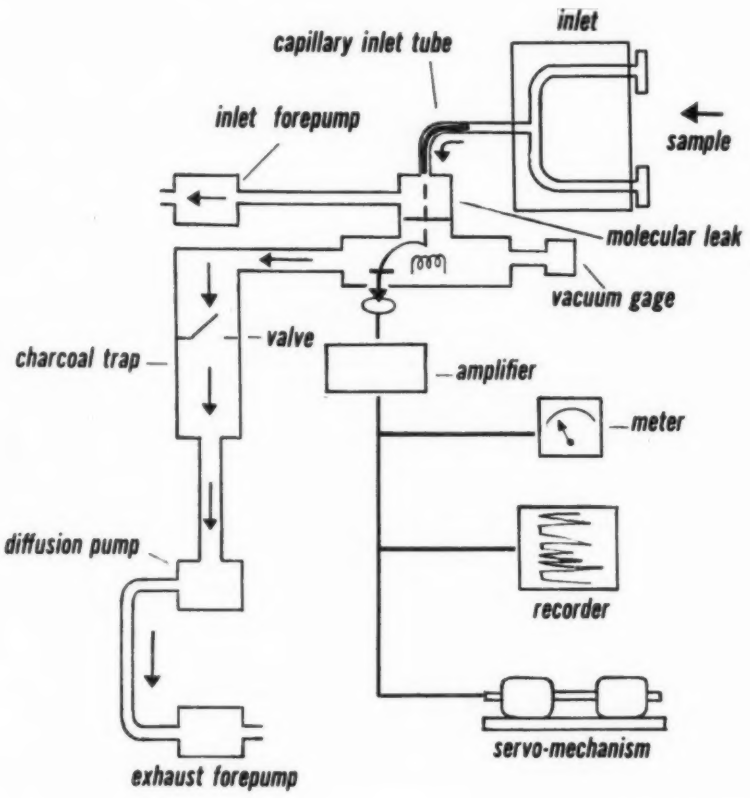


Fig. 8. Schematic diagram of mass spectrometer operation.

sample which passes through the small holes in the molecular leak is actually analyzed.

Every compound has a unique arrangement of the atoms within its molecules. The manner in which its molecules break up into charged fragments (ions) when bombarded by a stream of electrons in a mass spectrometer is the basis of a method of detection and analysis. A separation of the molecular fragments, or ions, for individual identification is achieved by electrically accelerating them into a strong magnetic field. The mass (weight) and velocity of the particles cause them to travel in a particular path so that they may be collected by striking a target.

The collector is connected to a highly stable amplifier which raises the minute electrical signals produced by the impinging ions to a level suitable for direct indication of ion abundance on meters and chart recorders, or for operation of servo-mechanisms and other control equipment.

In laboratory form, the mass spectrometer found ready acceptance throughout the world. However, as the techniques advanced and more experience was gained with the instrument, a concentrated effort was made to adapt the mass spectrometer for plant use. The result was a miniaturizing of components as this knowledge became available from allied electronic applications.

Soon two new models were available which not only were reduced in size and, therefore, complexity, but also provided the facility of continuous analysis. The earlier model was a batch type instrument. The smaller instruments found ready acceptance in large control laboratories, and in natural gas plants. Even the earlier large instrument was being used to do 30 to 40 analyses per day by one large mid-continent natural gas research laboratory.

Within the last two years even the intermediate-size mass spectrometer was further reduced in size so that it now operates as a module instrument of table-top height (*see Fig. 9*). This reduction in size in no way reduced the accuracy or sensitivity of performance of the equipment. Rather, through use of transistors, printed circuits, and other advances in the field of electronic component design, the new mass spectrometer is now available as either a batch type inlet or as a continuous inlet analyzer. For continuous and routine laboratory analyses of the lighter hydrocarbon fractions through C4's, for example, this instrument now offers the user all the advantages of immediate response and high sensitivity in the determination of such hydrocarbon compounds in plant gas streams.

As the general field of both laboratory and continuous stream analysis continues to develop and progress, we shall see further advances made in this art. For now, we have instrumentation which can continuously monitor that most important of all parameters—end product quality. The advantages of such an instrumentation approach are obvious to all levels of people in the natural gas industry. To management, it means that immediate results are available as to both quantity and quality of the end product to be sold and on which basis the profit is made. To the chemical engineer and process designer, the new analytical instrumentation approach offers an immediate checkout of process calculations and plant design. To the operator, it means he no longer need control his plant operations by the seat of his pants. He has available, even under the inherent batch principle of chromatography, a continuous readout of the concentration of key components of major interest. This display means he has at his fingertips the information necessary for optimum operation and control of his particular plant. To the instrument man, it means that there are now available instruments which in their design concepts completely embrace conventional criteria for plant operation in all types of weather, under all types of atmospheric conditions. To the industry at large, the new developments in the techniques of stream analysis offer the advantages of reduced laboratory burden and the potential elimination of errors and inaccuracies due to human frailty and failure.

These new instruments are completely automatic. And, they are unaffected by changes in the weather, cold coffee, or sleepless nights. ■

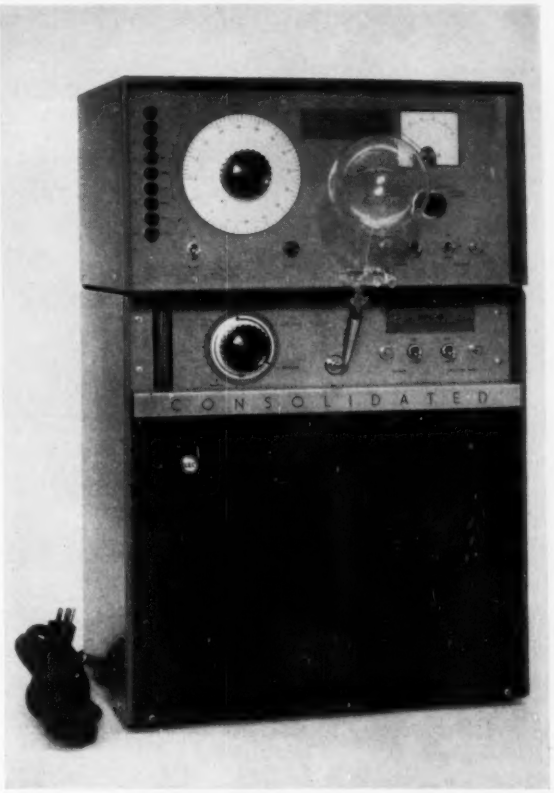


Fig. 9. Intermediate size mass spectrometer is now a table top height instrument.

Diagnosing a problem on a 5-ton Arkla Servel unit in Lone Star's appliance training room.

GAS exclusive

A GUIDE TO TRAINING SERVICEMEN— 3

Gas air conditioners

THE use of expertly trained servicemen to give prompt and thorough air conditioning service has paid off in increased sales of gas air conditioners for Lone Star Gas Co.'s Dallas division of distribution.

By the end of 1958, despite lower competitive prices of other units, the company had sold and installed 1136 gas air conditioners in the Dallas distribution areas. These include 1095 Servel and Arkla units, 5 Bryant absorption units, 19 Weatherbuster units, and 17 Ready Power units. The Weatherbuster and Ready Power units are gas engine-driven compressor systems.

The company's air conditioning service program begins with a vigilant maintenance of the customer's service records at the central service center where they are available to the engineer in charge and to the dispatcher. The records consist of (1) blue prints of duct layout, (2) a contract file which contains a copy of the original installation agreement, a copy of the service contract, if any, and information regarding equipment that has been replaced since the job was put in, (3) the customer's service record which shows the customer's name, address, number and type of equipment, date installed, start-up date, date of all service calls made, the nature of the call, and the work done. If the unit is serviced under a service contract, the information aids in determining for what part of the work the customer is to be billed.

Lone Star offers its customers a choice of service agreements. During the first 12 months after start up, units are serviced free of charge as a part of the warranty agreement. Following that, the customer

By J. A. HAYES, Superintendent, Shops Department
Dallas Division of Distribution
Lone Star Gas Co., Dallas

Parts and equipment carried on service trucks.

has an option of signing a service contract or having the company service the unit on a time and material basis.

The service contract agreement provides for three service calls annually. The first is made early in spring to prepare the equipment for summer operation. During this call, motors and bearings are oiled; filters are changed; the condensing water system is cleaned and filled; the unit is checked out on the cooling cycle, and all safety controls are inspected and made to operate. The second call is made in midsummer when the condensing water system is cleaned; motors and bearings are oiled, and filters are cleaned. In the late fall the final service call is made to drain the condensing water system, change filters again, oil motors and bearings, and make all safety controls operate.

During these routine service calls any maintenance which appears necessary to keep the equipment in good operating condition is reported. Arrangements are made with the customer for repairs either on a time and material charge or for a stipulated unit change-out price, whichever is applicable. Approximately 65 per cent of Lone Star's customers take advantage of the service contract.

Within the limits of good design and installation practices, initial costs of jobs are kept as low as possible; however, emphasis is placed on prompt and dependable service rather than initial cost. The company attributes most of its progress in the air conditioning field to this approach.

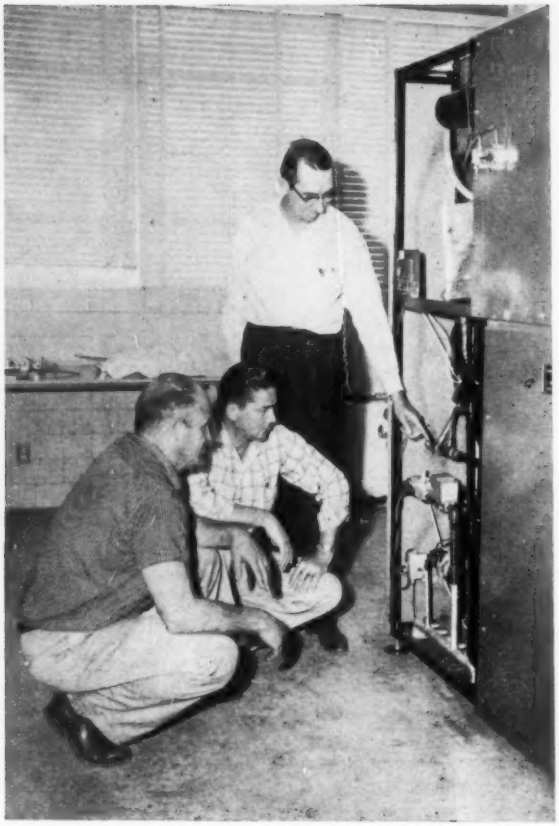
Servicemen are regularly on duty from 8 a.m. until 9 p.m. each work day and from 9 a.m. to 6 p.m. on Sundays and holidays. Outside of these hours a standby service is maintained for emergencies only. An emergency is any condition that might endanger life, health, or property. Personal discomfort would not necessarily be considered such. A complaint of insufficient cooling at 11 p.m. would not be considered an emergency; however, a no-heat complaint during bitter cold weather would.

All service calls taken during any given day are worked during that day if they involve unsatisfactory performance or interruption of the heating or cooling cycle. A working stock of units, motors, boilers, and other parts is maintained at all times. In the event

Beginners' Course

1. Simple electric circuits.
2. Electrical controls and devices, such as relays, electric motor starters, pressure switches, float switches, thermal switches, and thermostats.
3. Schematic wiring diagrams of various equipment.
4. Special relay control equipment.
5. Electrical circuits for automatic winter drain systems.
6. Refrigeration cycle of Servel and Arkla absorption systems.
7. Cooling cycle unit analysis including method of determining normal and abnormal functioning of the cooling unit by temperature and pressure readings.
8. Cooling tower performance — water flow and water temperature in relation to outside wet bulb temperature.
9. Unsatisfactory cooling tower performance — insufficient water and air flow and the cause of each of these.
10. Condensing water systems — the use of bleed-off water and flue gas treatment.
11. Service to boilers and boiler controls.
12. Location and correction of objectionable noises in equipment.
13. Routine safety inspections of equipment—inspection of vents and/or flues, return air ducts within the equipment room, access panels to heating coil and filter sections, and condensate drains.

Classroom scene during advanced course in air conditioning service.



Lone Star service specialist explains the location and function of various controls on the Arkla Servel unit.

of a unit failure within the warranty period, it is possible to have a replacement unit in operation by the following day. Units that fail beyond the warranty period can be replaced as soon as agreement is reached with the customer.

Nine service trucks with utility-type bodies are equipped with mobile radio sending and receiving sets. Work is dispatched to these trucks during the day from central service center. They carry belts, motors, pumps, relays, fuses, steam hose and clamps, gaskets, sight glasses, solenoid valves, thermostats, fan switches, and other small parts in addition to a minimum stock of small fittings for connecting pumps and related equipment. Certain trucks are equipped with special tools, such as vacuum pumps, draft gauges, vacuum gauges, and acidizing equipment.

The only electrical repair work sent out is for rewinding and replacement of motor shafts. A repair shop is maintained at central service center where motor bearings, starter switches, condensers, and overload protectors are repaired or replaced. Pump seals, impellers, and housing also are repaired or replaced. Motors and pumps are cleaned, painted, and shop tested.

In addition to motor and pump repairs, cooling tower spray headers and steam diverter valves are reconditioned and rebuilt. Compressors and engines from Weatherbuster units are also repaired in the shop. This work is usually done in the off season. Most overhaul and repair work on Ready Power units is done on the job because of the difficulty of removing such heavy equipment. This work is also done during the winter when the equipment is not in use.

The air conditioning service and installation department has compiled a service data book which is issued to all air conditioning service personnel. The information in this book is a condensed version of manufacturers' data. The electrical control plans furnished by the manufacturer are remade into schematic prints. The data book also contains important information such as gas manifold pressure, pressure drop across cooling coils, pressure drop in condensing water circuit across the unit, procedures for purging noncondensible gases from the different units, and certain formulas used in the service analysis of the equipment. A copy of the work and service checks to be made on each routine service call is included in the book.

These data are kept as up to date as possible. When modifications are made in equipment, the information is given to each man to make proper corrections in his book. As new models of equipment are received, any additional information that might be useful to the serviceman is added to the book.

In order to maintain this type of quality service, it is necessary to carry on an extensive training program. On-the-job training is supplemented by intensive classroom and laboratory work during the off

Advanced Course

I. Weatherbuster and Ready Power freon compression systems.

A. Theory of freon compression cycle.
   1. Installation of equipment and grading of pipes and traps.
   2. Component parts and their functions.
   3. Electrical circuits and control equipment.
   4. Purpose and function of engine controls.

B. Service diagnosis and correction.
   1. Expansion valves.
      a. Expansion valves not controlled properly.
      b. Oversize valve.
      c. Stoppage.
      d. Incorrect power element.
      e. Power element control bulb not located properly, not insulated, or not in contact with suction line.
      f. Defective power element.
   2. Head pressure too high.
      a. Air in system.
      b. Overcharge of refrigerant.
      c. Improper transfer of heat in condenser caused by insufficient air, water flow, or scaling.
   3. Suction pressure too low.
      a. Low charge of refrigerant.
      b. Restriction in freon system, such as stoppage in strainer, dryer, solenoid valve, liquid distributor, evaporator, or suction line.
      c. Improper heat transfer in evaporator caused by low air flow, or excessive circulation of compressor oil.
      d. Defective expansion valve due to loss of charge in the power element.
      e. Engine speed too high.
   4. Suction pressure too high.
      a. Engine speed too low.
      b. Compressor valve leaking.
      c. Excessive load condition.
   5. Interruption of refrigeration cycle caused by engine controls.
      a. Engine oil pressure.
      b. Loss of engine cooling water.
      c. Electrical overload safety devices.

II. Arkla Servel chilled water systems.

A. Surging boilers.
   1. Oil skims and other matter that collect.
   2. Skimming and purging boilers.

B. Abnormal operation of the refrigeration unit.
   1. Noncondensible gases, such as hydrogen and air.
   2. Steam input — methods used to measure quantity.
   3. Quantity and temperature of condensing water.
   4. Internal malfunction of the refrigeration unit, such as over concentration of solution or internal leaks.
   5. Unit not level.
   6. Interruptions caused by safety controls.

C. Chilled water flow not properly regulated.
   1. Stoppage in strainers.
   2. Pump failure.
   3. Air lock in chilled water system.
   4. Failures in electrical equipment.

III. Bryant gas-fired chilled water systems.

A. Refrigeration cycle.
B. Electrical circuits, controls, and related equipment.
C. Methods of handling ammonia and precautions to be taken.
D. The use of temperature pressure relationship analysis to determine normal or abnormal operation.
E. Field replacement of parts of the refrigeration unit.

IV. Routine safety precautions

A. Vents and/or flues.
B. Portions of the system containing negative pressures that are within the equipment room.
   1. Return duct.
   2. Access panels to heating coil.
   3. Filter access panel.
C. Condensate drains.

Serviceman repairs electric motor and pump.

season, usually during February and the first half of March. Two 40-hour courses of instruction are offered: a basic course for relatively inexperienced personnel and an advanced service school for those who have already acquired considerable experience.

The subjects covered for those with limited experience are shown in the accompanying box.

All service data made available by the manufacturer are used in this course.

The advanced course for service personnel begins with a review of subjects covered in the basic course. Then, the class gets immediately into methods of diagnosing service problems and correcting equipment failures on Weatherbuster and Ready Power freon compression systems and on Servel and Bryant chilled water systems.

A written examination is given following each course. Employees are required to make a satisfactory showing to advance in the department.

Employees who have completed both courses are brought in annually for a review, and for study of new equipment and modifications to existing equipment. ■

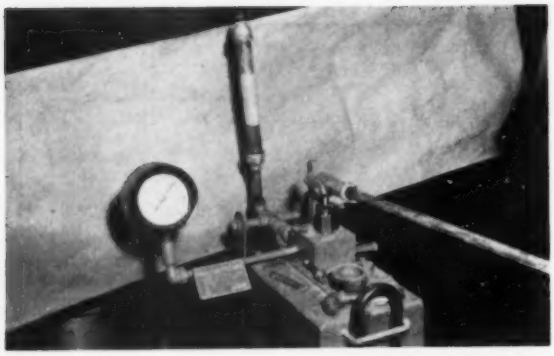


Fig. 1. A piece of 1.25-in. steel pipe withstands hydrostatic pressure test of 2000 psig after a dozen quarter-inch holes in it were repaired with Epi-Seal.

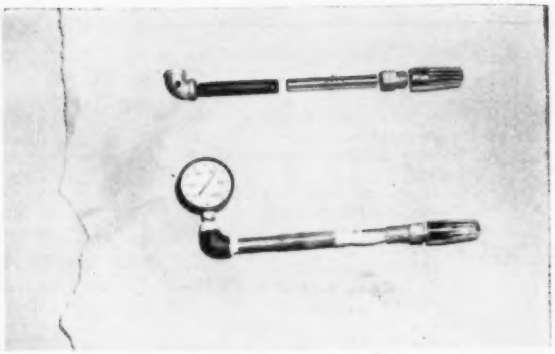


Fig. 2. Four different materials (from left: cast iron, steel, copper, brass) were repaired and joined and withstood pressure of over 600 psig in test.

New gas pipe repair 'package' demonstrated

AN emergency gas pipe repair kit that requires no special tools and can be used on nearly all types of mains was recently demonstrated by Bonded Products Inc. at its Orange, N. J., plant.

The Epi-Seal Gas Repair Kit provides fast and effective stoppage of leaks in most any size of main, particularly those 10-in. OD and smaller, Bonded Products President Hanford Z. Hight claims.

During the demonstration a foot long section of 1.25-in. steel pipe was drilled full of 0.25-in. diameter holes, then repaired and hydrostatically tested. It withstood 2000 psig during the demonstration test with no sign of leakage (Fig. 1). It was also shown that the kit's contents can be used to join together such materials as cast iron, steel, copper and brass. A combination of these were lined up (Fig. 2) and joined by using various components of the kit. These joints withstood 600 psig.

The kit, which measures 5x10x13-in. and weighs about 12 lb, contains everything needed to repair almost any kind of leak that gas crews might encounter. Included in the package are 12 units of tube-in-tube, 12 strips of spun-glass tape (2- x 30-in.), 12 bags of iron putty reinforcer, 12 bags of caulking compound reinforcer, 12 mixing containers, 12 application brushes, 12 stirring tools, 12 pairs of polyethylene gloves, 1 can of cleaning fluid, 1 roll of sandpaper and 1 non-sparking wire brush.

Use of the tube-in-tube (Fig. 3) to repair a leaking pipe is shown in Figs. 4 through 7.

The kit's other uses were shown, too. Leaks in joints and fittings were repaired (Fig. 8) using primarily the same methods. Also demonstrated was the technique used in sealing larger holes (up to about 1-in. diameter), or for repairing leaks in bell and spigot joints. In this process, a third component, a reinforcer, is added to the resin-activator, making the solution considerably thicker. The mixture then was forced into the hole with a wooden paddle. It formed a cement-like button through the hole onto the inside of the pipe. Then, the same wrapping process followed. The pipe withstood 1500 psig (Fig. 10) when tested.

The Epi-Seal process originally was developed for maritime use on high pressure steam lines. The manufacturer guarantees the product to withstand 500 psig. ■

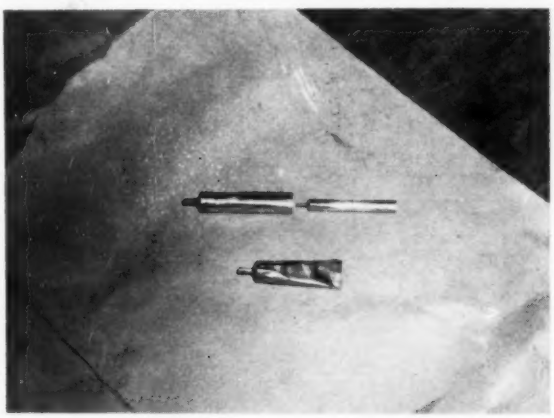


Fig. 3. The tube-in-tube makeup is illustrated here. Upper tube, filled with resin, is inserted into another tube filled with an activator. Both are then sealed together (lower tube).

Fig. 4. Technician squeezes both resin and activator in a mixing cup in first stage of repairing pipe.

Fig. 5. Pipe being repaired is shown here being coated with the contents of the tube-in-tube solution.

Fig. 6. A spun-glass cloth tape, saturated with the tube-in-tube solution, is wrapped around the damaged area of the pipe.

Fig. 7. Using the remainder of the tube-in-tube solution, the technician "paints" several coatings over the spun-glass cloth tape.

Fig. 8. Shown here is an Epi-Seal repair made on a joint of a piece of gas service pipe.

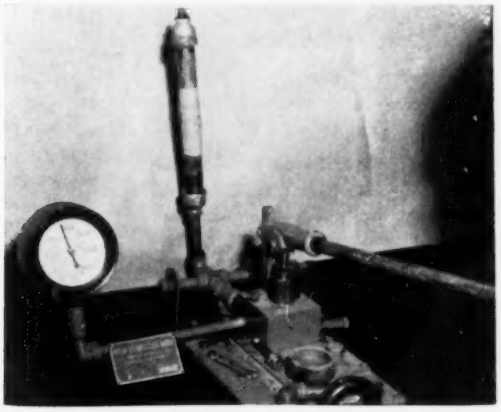


Fig. 9. With the reinforcer filling a 1-in. hole, this pipe holds firm at 1500 psig during hydrostatic test.

GAS · DISTRIBUTION NEWS

Colorado coal mine tested for storage

Conversion of a coal mine to underground gas storage is being studied by Public Service Co. of Colorado. This is the first time an abandoned coal mine has been used for such a purpose. The mine is located near the town of Arvada, not far from Denver.

Tests to determine if the mine is gas tight are under way. In 47 years of operation, some 6 million tons of coal came from the Leyden lignite mine, leaving a cavern of 150 million cu ft. If tests prove out, it is estimated that 3 billion cu ft of gas can be stored in the cavern under 300 psi pressure.

The mine is now presumably full of water. Because the core seam slopes downward some 200 ft from north to south, it is possible that a pocket of trapped air may now exist above the water level in the the north end of the mine. Injection wells are now being drilled in this area through which gas will be injected under pressure. When an 8-mile gas line to the mine site is completed, some 115 MMcf of gas will be injected into the northern end of the mine. If that portion is found to be gas tight, the mine's four shafts will be sealed and the rest of the mine filled with gas to test the entire vault for storage.

Southern California Gas Co.'s southeast division is solving problems of continual rapid growth and development in a once rural section with a specially designed headquarters building of flexible construction capable of expanding with the area it serves. Shown here is the attention-getting blue flame symbol of the gas industry, visible day and night. The 60-ft pylon rises in front of the new building in Downey. Ceramic tile murals at the base of the pylon tell the natural gas story.

Savannah Gas expands

Savannah Gas Co. has permission to extend its distribution system to include the Georgia cities of Rincon, Guyton, and Springfield. Construction of distribution systems in the three cities is under way under direction of the Latex Construction Co.

Gas heat customers up 6 per cent in '58

More than 1 million residential heating customers were added in 1958, according to the AGA. The 1,079,000 new customers represent a 6 per cent increase over 1957 and bring the total to 19,003,000.

Nearly 65 per cent of all residential gas customers now heat their homes with gas, a gain of 2.3 per cent from 62.6 per cent a year ago.

AGA estimates that 4 million new gas householding customers will be added during the next three heating seasons. New homes are expected to account for 2.3 million while conversions from other fuels will account for the remaining 1.7 million.

About 1.1 million will be in Illinois, Indiana, Michigan, Ohio and Wisconsin. The Pacific region (California, Oregon, and Washington) will connect 628,000 customers. New York, New Jersey and Pennsylvania will add 526,000 by the end of the 1961-62 season.

Florida, now with about 105,000 gas heat customers, will gain an estimated 148,000 new customers in the three-year period. The largest single gain is expected in California, where an estimated 552,000 additional dwellings will use gas heat by the end of the 1961-62 season. Illinois ranks second with 398,000, Michigan third with 292,000 and New York and Ohio in a fourth-place tie with 258,000 each.

There are more than 6000 types and sizes of Dresser® service fittings!

regular...

insulating...

extra rugged...

easily installed...

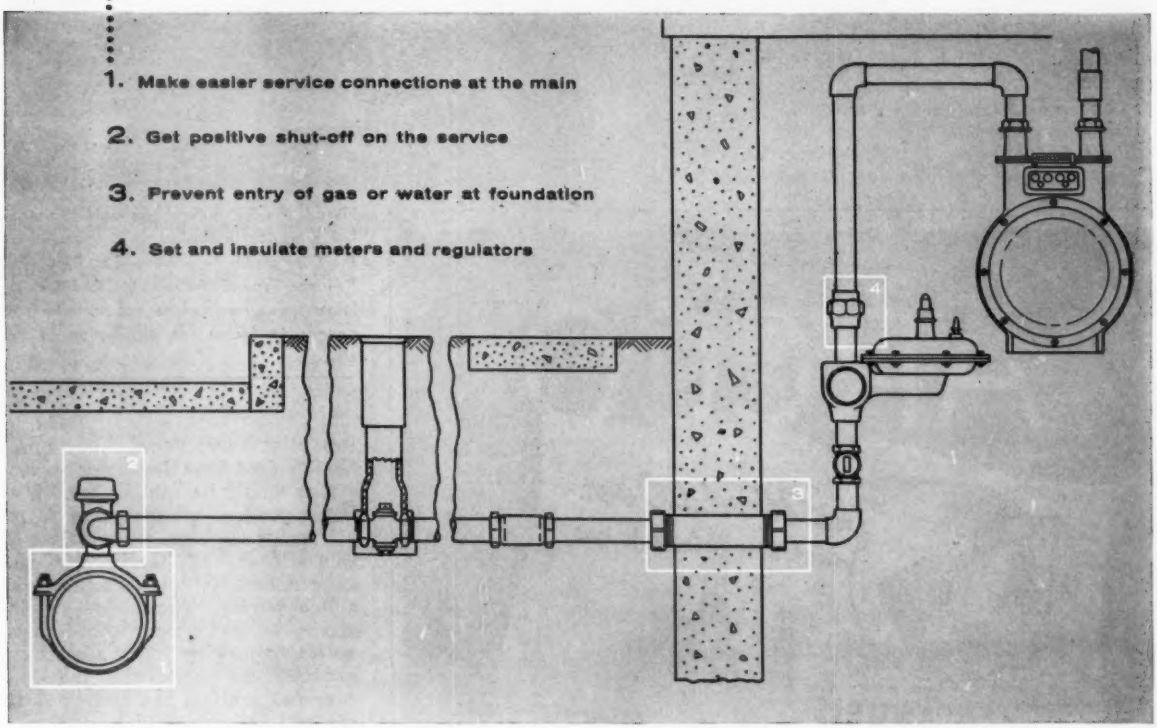
permanently gas-tight.

Dresser is the only manufacturer supplying a pipe coupling or fitting for every need in the gas industry.

DRESSER MANUFACTURING DIVISION

Bradford, Pennsylvania

Four ways to simplify service line installations:


1. Make easier service connections at the main
2. Get positive shut-off on the service
3. Prevent entry of gas or water at foundation
4. Set and insulate meters and regulators

1. Make service connections at the main

NEW STYLE 91 SERVICE SADDLE gives you a quicker way to make permanent connections on steel or cast-iron pipe. High tensile steel straps conform snugly to the outside of the pipe; broad bearing surface prevents cutting or crushing. Available with single or double strap, tap size up to 2-inches.

2. Get positive shut-off on the service

NEW STYLE 90 CONVERTIBLE TEE (shown above with 90° Street Ell as a swing joint) serves both as a service connection or as a safe positive shut-off on pressures up to 250 psi (or 150 psi for the malleable style). Meets ASA requirements that provision always be made for sealing off abandoned services. Furnished with either threaded end or beveled for welding.

3. Prevent entry of gas or water at foundation

NEW "WALL-SEAL"...a simple leak-proof method of sealing between the wall opening and service pipe. Simply use a threaded nipple . . . and two special Dresser compression follower nuts and wedge gaskets. Eliminates the aggravation of having to pack the space with tar, rags, etc.

4. Set meters and regulators

NEW INSULOK ADAPTER...insulates, simplifies and speeds setting of regulators and meters. Blocks harmful flow of current between house and main. Virtually tamperproof. Can be used practically anywhere on the riser, on the high or low-pressure side of regulator...indoors or out. Facilitates pre-make-up of the riser assembly in shop or truck.

Unlike welded or threaded connections, the Dresser method gives you a non-rigid service which will absorb ordinary stresses and movement without leakage or damage. Dresser® special-compound gaskets stay resilient and gas-tight for the life of the line, And regardless of the type or location of the connection, a Dresser fitting goes on faster... the only tool you need is a wrench. The complete line of Dresser service fittings includes "a product to meet every practice."

DRESSER
MANUFACTURING DIVISION
ONE OF THE DRESSER INDUSTRIES

Bradford, Pennsylvania • Chicago • Houston
New York • S. San Francisco • Toronto & Calgary

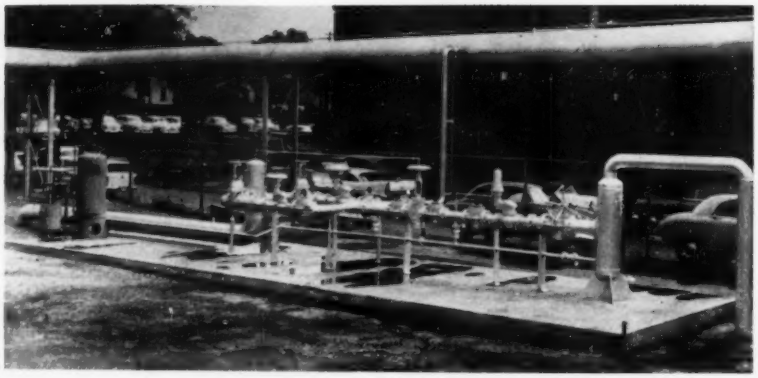
Sweepstakes boosting Gold Star promotion

Tying in closely with the AGA's $30 million Gold Star promotion program is the promotion and advertising campaign of the three Pittsburgh gas companies.

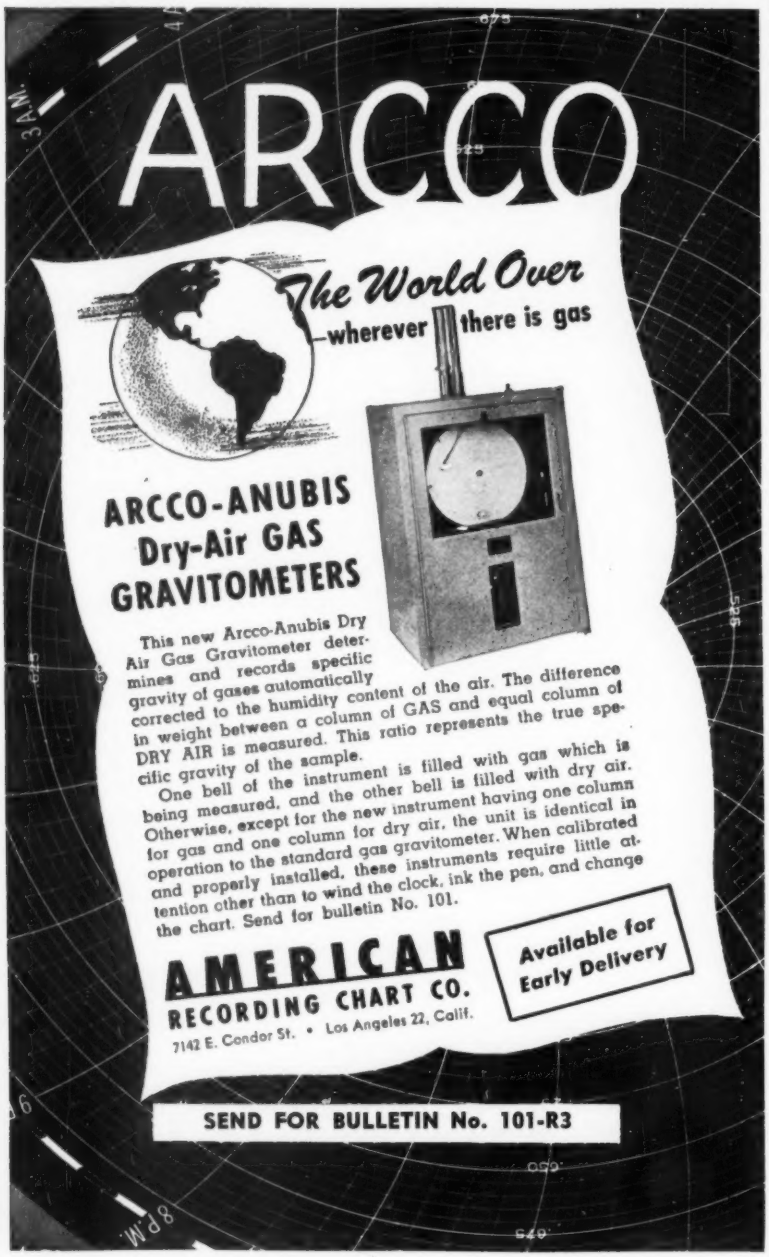
The program began with mass dealer meetings sponsored by Equitable Gas, Manunufacturers Light & Heat, and Peoples Natural Gas. Some 1200 dealers and salesmen dined and then were entertained by the AGA musical spectacular movie, "Gold Star Review." At the meetings it was announced that a spectacular Gold Star Consumer Sweepstakes would be held in the Pittsburgh area.

The Sweepstakes offers prizes of $5000 cash, 22 Gold Star gas ranges, and 500 women's Starlight clutch purses. The contest is designed to send people into dealers' stores to pick up entry blanks, to acquaint the public with the Gold Star designation, and to help dealers and salesmen sell larger volumes.

A sweeping newspaper, radio, and television advertising campaign is backing the Sweepstakes. All advertising is designed to build store traffic for dealers.



Here is the first natural gas main city regulation station in Florida. It is operated by the City of St. Petersburg Gas Dept. The Reliance Type CBV-301 and CBV-201 regulators shown here reduce gas pressure from pounds to inches for distribution in the city.


ARCCO
The World Over
—wherever there is gas
ARCCO-ANUBIS
Dry-Air GAS
GRAVITOMETERS
This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.
AMERICAN
RECORDING CHART CO.
7142 E. Condor St. • Los Angeles 22, Calif.
Available for Early Delivery
SEND FOR BULLETIN No. 101-R3

Florida's City Gas Co. continues expansion

City Gas Co., Hialeah, Fla., has purchased Dade Gas Corp. Acquisition of the Dade company, which serves LPG to more than 30,000 customers in the Dade county area, marks another step in the City Gas five-year, $5 million expansion program announced by President Sam F. Daniels.

City Gas now has more than 45,000 customers in the Dade and Broward county areas.

The company is spending some $1.5 million on its expansion program this year. Included in the program is expansion of its present lines into areas scheduled for residential and commercial development and improvement of existing facilities in anticipation of the arrival of natural gas.

PUAA honors utility advertising

Ninety-seven utilities won outstanding honors in the field of advertising at the annual convention of the Public Utilities Advertising Association.

More than 2000 entries were received in this year's contest. In all, 156 awards were presented.

Leading the field was Pacific Gas & Electric Co., San Francisco, with four first places, two second places, and three third place awards.

Wisconsin Public Service Corp., Green Bay, won five awards. Among companies winning four awards each were Consolidated Edison Co. of New York, Philadelphia (Pa.) Electric Co., and Laclede Gas Co., St. Louis.

Three awards each were won by Hope Natural Gas Co., Clarksburg, W. Va.; South Jersey Gas Co., Atlantic City; and Cincinnati (Ohio) Gas & Electric.

ALG subsidiary enters retail gasoline business

Continuing its broad diversification and expansion program, an Arkansas Louisiana Gas Co. subsidiary, Arkansas Louisiana Chemical Co., is entering the retail gasoline business. Up until now, the chemical company has been producing motor fuels for wholesale distribution.

According to President W. R. Stephens, "Arkla Service Centers" will be built and operated in Louisiana, Arkansas, and east Texas. The first center, in El Dorado, Ark., is slated for operation by late summer.

The new stations will market a complete line of motor fuels under the brand name "Arktane," in addition to motor oils and other automotive accessories, providing an outlet for products produced primarily from eight gasoline plants operated by the chemical company. These products also include LPG, which the service centers will market where conditions warrant.

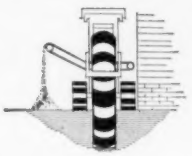
A unique feature of the centers will be a display room adjoining each station where other products of Arkansas Louisiana subsidiaries will be displayed. Also, where feasible, the service centers will have drive-in windows with a full-time attendant where gas company customers will be able to pay their monthly bills.

More news on page 94

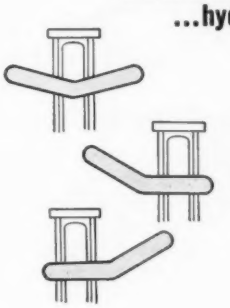
THE MACHINE / for distribution digging

...the new Cleveland J-20 trencher

- less than 5' wide over its crawlers
- digs 13" to 24" wide, down to 5' 6" deep
- puts 24" trench within 20 inches of a parallel wall
- maneuverable full crawler mounting... perfect balance and stability, easy on lawns and sidewalks
- fast, accurate, clean, dependable... nothing digs trench like a Cleveland



Cleveland's unique new V conveyor ...hydraulically shifted... independently driven



- digs past poles, trees, shrubs... places spoil where needed — without interrupting other operations
- lever at operator's seat controls hydraulic shifting and positioning of conveyor
- dual independent hydraulic drive gives operator fingertip control of conveyor belt direction and speed — independent of all other operations
- self-contained hydraulic motor and planetary gear drives in each head pulley eliminate all conveyor chains and sprockets
- provides constant elevating angle for faster, higher spoil discharge
- Maximum clearance under digging wheel rims permits higher heaped loads without clogging
- conveyor design reduces rolling and tumbling

world's finest trencher crawlers

...double flanged sprockets, rollers, wheels... drives on each end of 1½" diameter hardened pins... sealed ball and roller bearings... 1,000 hour lubrication... a tremendously long-lived, easy-rolling track.

hydraulic crumbing shoe

...optional, extra... pivots upward... fingertip control makes crumbing shoe advantages practical in crowded digging conditions.

engine • crawlers • hoist • wheel crumbing shoe • conveyor speed-direction-shift / *Every operation controlled at operator's seat*

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

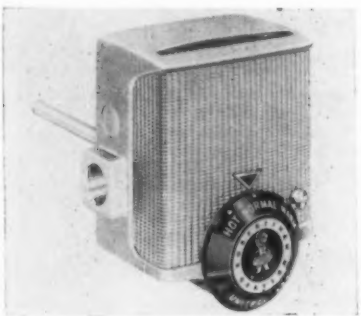
GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 91, 92

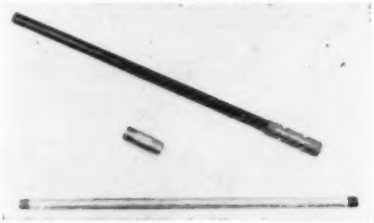
1. Mechanical force amplifier

The American force amplifier is an ultra sensitive yet rugged and flexible mechanical servo for the amplification of minute forces. It can be actuated directly by mechanical flow, pressure, or temperature measuring elements or similar motion producing devices. Less than 1 gram (0.04 oz) force is required to accurately position the amplifier. Its output can be used to position automatic controls, recording pens, encoders, small valves, actuate switches, or position pilots to control hydraulic servo systems.
American Meter Co.



2. Water heater control

Unitrol 400R with a flip-top lid is designed for use on deluxe and larger size water heaters. It incorporates pressure regulator and universal pilot gas filter which removes dust and gum. The control can be used on units with a burning rate as high as 100,000 Btu per hr. The easily removed cover discourages tampering with gas cock dial and reset button. Because only the temperature dial is exposed, dust accumulation is greatly reduced.
Grayson Controls Division

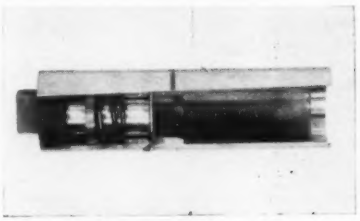


3. Pipe nipples

Reduction of field complaints to a negligible amount will result from use of three new types of pipe nipples, according to Perfection Pipe Nipple Co. The Coppersert nipple is used as both an inlet and outlet for water supply in water heater tanks. The Dip-Tube nipple combines in a single leakproof unit the inlet nipple and a kralastic, polypropylene or linear polyethylene dip tube. The third, Plasticsert, is a pipe nipple especially designed for cleanliness.
Perfection Pipe Nipple Co.

4. Lighted pushbutton

A new series of modular lighted indicator and pushbutton switch devices has been developed by Micro Switch. Termed Series 2, the new line allows flexibility for users of such modern control equipment as electronic data-processing equipment, computers, graphic flow meters, etc., where combined control and indicating functions often are desired.
Micro Switch



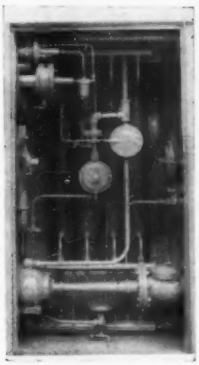
5. Terminal fitting

Future extension under pressure is possible with a new terminal fitting for welded gas lines. Used as an end cap, the fitting is capable of meeting any distribution pressure and can be operated at 20 to 40 lb. The fitting purges straight through. After disc is removed, the slot closes automatically. Following removal of disc, an outer sleeve is welded over slot to give a solid welded fitting—no threads, gaskets or plugs exposed.
Gas Safety Equipment Co.

6. Bimetal thermostat

A low-voltage, bimetal thermostat is offered as a companion to White-Rodgers' "Fashion" series. The new Customline 130 features several innovations in styling, installation ease and dial readability. The large dial with embossed gold

numerals and the recessed pointer-type thermometer allow the thermostat to be read easily from several feet away. To increase installation ease, the metal cover snaps on or off in one simple motion.
White-Rodgers Co.

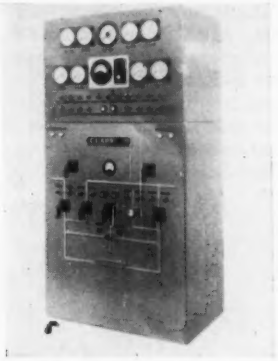


7. Vaporizer-mixer

Algas direct-fired combination LPG vaporizer-mixers are used for utility service, peak load shaving, and standby plant service. Automatic control of mixed gas production and heating value is maintained without depending on electric power. Turn down is 100 per cent. Several units can work together to produce total plant demand. Additional Algas units can be hooked on to increase plant capacity without disturbing existing plant or replacing existing equipment.
American Liquid Gas Corp.

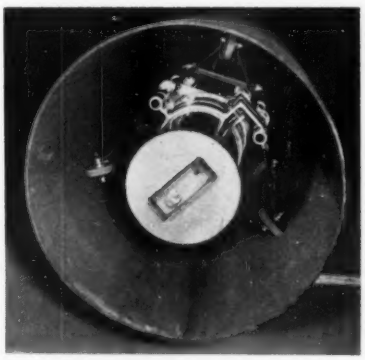
8. Corrosion

A portable test rectifier for determining cathodic protection current requirements to combat electrolytic corrosion in buried or submerged metal structures is available. To help the corrosion engineer's field work, the Harco 3-9 unit provides adjustable dc output on a timer-interrupted cycle or continuously. The unit consists of a transformer, selenium air-cooled rectifier, automatic built-in current interrupter, dc ammeter and voltmeter.
Harco Corp.



9. Pipeline automation

A new line of packaged control systems is designed for any degree of compressor automation. Consisting of three basic control panels, Clark "packaged automation" ranges from a simple engine start system to a fully automatic engine and compressor control for remote location. With the addition of a computer controller and telemetering equipment, any number of remote automatic panels can be combined for automation of a complete station or pipeline.
Clark Bros. Co.



10. Pipe X-ray

A new machine can radiograph every inch of every weld in a 40-ft length of pipe in less than one minute. Travel-Ray uses an X-ray tube which projects a narrow beam of parallel rays only, permitting radiography of the longitudinal welds in pipe sections while the X-ray source is in motion. Up to 2000 ft of pipe can be X-rayed in one continuous operation without stopping the machine.
Travel-Ray Corp.

11. Street tee

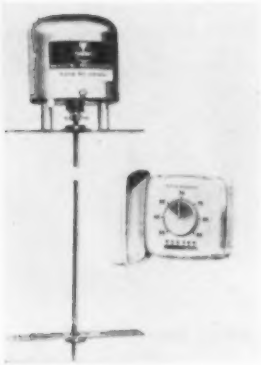
Dresser's new brass insulating street tee is recommended for use where excessive corrosion is a problem. Since the tee is cathodic to cast iron pipe and is insulated from the steel service line, it provides a long life connection, with positive insulation, between the two structures.
Dresser Manufacturing Div.

12. Semi-concealed control

Grayson's new semi-concealed 200R Unitrol gas water heater control features built-in pressure regulator. The neat, compact "streamliner" control lends a dramatic effect to the modern water heater. Incorporated are all the time-proved advantages of the Unitrol 200 with the added advantages of the built-in pressure regulator. Gas cock and reset pushbutton are concealed by a cover removable without tools. Temperature set dial is visible.
Grayson Controls Division

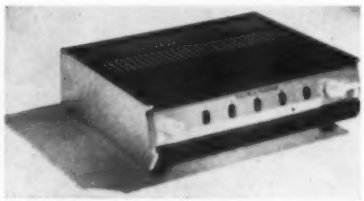
13. Floor tester

Immediate and accurate measurement of slippery floors is possible with the safe-test Slipmeter. With the Slipmeter, it's possible to maintain accurate records on floor surface conditions. It records on any type of surface—waxed floors and all types of walkway surfaces.
Frazier Engineering Corp.



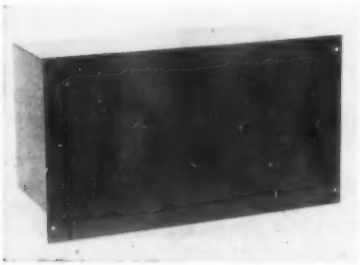
14. Control package

White-Rodgers has developed a combination control package for zoning forced-air heating-cooling systems. Called Zone-Air, the package delivers all the advantages of zone control, yet offers economical installation by use of simplified components and low-voltage wiring. Installation can be made anywhere on the ductwork of both new and existing systems. In use, one Zone-Air package zones each specific area of a building, such as bedrooms, living and recreation areas.
White-Rodgers Co.



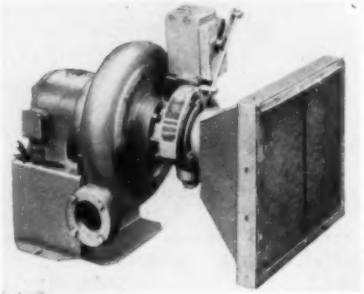
15. Desk communications

Talk-A-Phone has introduced a new model which is proportioned like a book, lies flat on the desk, and does away with the bulky, machine look of earlier intercom systems. The Chief and Deluxe series stand less than 3 in. high. Finish is brushed chrome and charcoal gray.
Talk-A-Phone Co.



16. Telemetering

An accurate industrial telemetering system that transmits over a single teletype, voice, or microwave channel, or a single metallic pair, has been developed. The system samples and telemeters remote measurements in gas pipeline systems. Its output signal is ideal for computer control, according to the manufacturer. The receiving unit of the ASCOP system shows the lack of operating controls. Even the power switch is placed back of the hinged front panel since the system is intended for indefinite unattended operation.
Applied Science Corp.



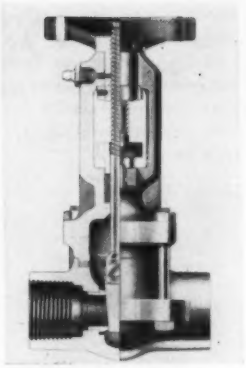
17. Air filters

A new line of air filters is for use on Unimix machines (air-gas premixers) and centrifugal pressure blowers used in gas and oil combustion systems. By safeguarding against foreign material entering the system, these filters prevent changes in critical gas-air mixtures, plugging of burner ports, and overcome unduly rapid equipment wear.
Eclipse Fuel Engineering Co.

---

18. Safety hat

Said to exceed government specifications is this new safety hat molded of high impact plastic with adjustable all plastic suspension. New features include suspension that can be adjusted exactly to head sizes from 6⅝ in. to 7¾ in. Headband fits back of head snugly.
Davis Emergency Equipment Co.



19. Ductile gate valves

Ductile iron's unique properties and specific design advantages are combined in a new line of ductile iron gate valves. Sizes range from ½ to 2 in. Ohio Injector's Pipe-Pal line is rated at 1000 psi for all temperatures from —20 deg. to 650 deg. F.
Ohio Injector Co.

---

20. Loader-digger

A new heavy duty front end loader and lightning power digger uses a common sub-frame and is powered from a single Sherman Hydra-Loop hydraulic system. Joining these two pieces of construction equipment has been made more effective with the development of an integrated hydraulic system.
Sherman Products Inc.

---

21. Lampadaire

The Lampadaire is designed to light poorly lit sidewalks, driveways, patios and swimming pools—for homes, motels, clubs, restaurants. Heavy gauge steel is combined with a black lustrous, long-lasting finish.
Roberts-Gordon Appliance Corp.

FOR MORE INFORMATION

about New Products in this Issue . . . . .

Each New Product or Trade Literature item reviewed in this issue is numbered. Circle the corresponding numbers on the Readers' Service Card; then PRINT your name, title, company and address plainly and drop the card in the mails (no postage is needed).

USE THESE POSTAGE FREE POST CARDS

Circle the number of the item requested

FIRST CLASS PERMIT NO. 6955 Los Angeles, Calif.

BUSINESS REPLY CARD
No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

GAS **Magazine, Readers' Service Dept.**
198 SOUTH ALVARADO STREET
LOS ANGELES 57, CALIFORNIA

GAS READERS' SERVICE DEPARTMENT

Please send me further information about the items circled below . . . .

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56
57	58	59	60	61	62	63

• *Please Print*

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY & STATE_____

July, 1959 • Void after 90 days

GAS READERS' SERVICE DEPARTMENT

Please send me further information about the items circled below . . . .

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56
57	58	59	60	61	62	63

• *Please Print*

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY & STATE_____

July, 1959 • Void after 90 days

FIRST CLASS
PERMIT NO. 6955
Los Angeles, Calif.

BUSINESS REPLY CARD
No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

GAS Magazine, Readers' Service Dept.
198 SOUTH ALVARADO STREET
LOS ANGELES 57, CALIFORNIA

FOR MORE INFORMATION

about New Products in this Issue . . . . .

Each New Product or Trade Literature item reviewed in this issue is numbered. Circle the corresponding numbers on the Readers' Service Card; then PRINT your name, title, company and address plainly and drop the card in the mails (no postage is needed).

FIRST CLASS
PERMIT NO. 6955
Los Angeles, Calif.

BUSINESS REPLY CARD
No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

GAS Magazine, Readers' Service Dept.
198 SOUTH ALVARADO STREET
LOS ANGELES 57, CALIFORNIA

GAS READERS' SERVICE DEPARTMENT

Please send me further information about the items circled below . . . .

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56
57	58	59	60	61	62	63

• *Please Print*

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY & STATE_____

July, 1959 • Void after 90 days

USE THESE POSTAGE FREE POST CARDS

Circle the number of the item requested

22. Matched pair

A matched pair of Humphrey Gay-Lawn and Cheer-Glo gas lamps is available. For patio, garden, and driveway, the Gay-Lawn has a spiral post for antique effect. Valve is brass, working parts of non-rusting aluminum alloys.
General Gas Light Co.

23. Gas lamps

Falcon is producing its gas lights in colored finishes—classic bronze, traditional copper-tones, white, or black. The lamps also will have post or wall bracket to match the color. Finishes are bonderized and phosphated.
Falcon Manufacturing Co.

24. Torch lights

Valley Manufacturing's Torchlites are designed to be installed either singly or in clusters. They do not require mantles and burn with foot-high dancing yellow flame. Two styles are now available: classic, a modern adaptation of an antique lamp, and Luau, the Hawaiian feast torch.
Valley Manufacturing Co.

TRADE LITERATURE

25. Packaged controls

Just issued by Clark Bros. Co. is Bulletin 170, presenting the company's packaged automatic control panels for gas engine-driven compressors. Three basic control panels are described: Model SE, sequenced engine control; Model SEC, fully automatic engine and compressor control; and Model SEC-R, fully automatic control for remote location.
Clark Bros. Co.

26. Pipe valve locator

A new transistorized pipe valve and cable locator is described in literature from Gardiner Electronics. The instrument locates valve covers, survey markers, meter covers, and shallow pipe.
Gardiner Electronics Co.

27. Gas separators

A new method of sizing oil and gas separators quickly and accurately for a wide range of well stream conditions has been published by Black, Sivalls & Bryson in a 114-page catalog (No. 30). The new sizing method reduces affecting conditions and characteristics to factors, and incorporates these factors into a universally applicable equation.
Black, Sivalls & Bryson

28. Trenchers

Three new Cleveland J trenchers are discussed in a 4-page folder. Text—aided by a series of simplified mechanical illustrations — describes the new design and construction features in terms of how they improve the operation of the trenchers.
Cleveland Trencher Co.

29. Lab services

Analytical laboratory services offered by the Analytical and Control Instrument division of CEC are described in a 4-page brochure (No. 1813). Presented are details on the rapid, precision mass spectrometer analyses which CEC provides, together with a typical report of analysis, sample requirements, information needed, and time required for complete analysis.
Consolidated Electrodynamics

30. Gas refrigerator

Kirk Industries new gas refrigerator is described in a catalog sheet. The refrigerator—designed for built-in or free-standing installation—features 34-lb freezing compartment, full width vegetable crisper, 12-way temperature control, plus many other features.
Kirk Industries, Inc.

31. System analytic service

IGT has published a 14-page booklet describing the computer services it offers for gas distribution system design. The brochure describes the facilities available at the institute and gives information on the procedure for submitting a problem and the approximate cost for solution.
Institute of Gas Technology

32. Plastic pipe

"Questions and Answers About Rigid Plastic Pipe Made of ABS Plastics" is the title of a new folder issued by Marbon Chemical. The folder provides basic performance and installation facts as well as benefits offered by ABS pipe when used in installations as gas distribution systems.
Marbon Chemical Division

33. Mass spectrometer

Details of a new mass spectrometer are covered in a 16-page illustrated brochure from CEC. Bulletin 1800 describes the principles and operation of the Type 21-103C mass spectrometer.
Consolidated Electrodynamics

34. Automation

Advantages of common language tape and edge-punched card machines are described in an 8-page booklet from Remington Rand. With the electronic Synchro-Tap typewriter, office machines and procedures are integrated for complete automation, including inter-office wire communication.
Remington Rand Division

35. Battery-powered winch

A catalog sheet is available on the Little Tiger Battery-powered winch. With the winch, the company reports, truck use is increased, labor costs are cut, and injuries are prevented.
Tiger Manufacturing Co.

THE KEY TO YOUR UNACCOUNTED-FOR PROBLEM

LEAKAGE REPAIRS by SOUTHERN CROSS FORESTERS

Atlanta 6, Ga. MElrose 4-4227

Safety record was best in '58

For the 11th consecutive year, the gas industry improved its safety record, the AGA reports. According to the report, 1958 was one of the best years in industry history.

An all-time low of 8.07 disabling injuries per million manhours was recorded, compared with the post-war peak of 21.86 in 1947 and the best previous rate of 8.08 set in 1957.

Although the accident frequency rate improved, there was an increase in accident severity. The severity rate was 683 last year (number of days charged to disabling injuries per million manhours worked), up from an all time low of 462 in 1957.

Research center planned

Bucyrus-Erie Co., South Milwaukee, is establishing a research center at its Oak Creek test ground. The one-story building, on a 125-acre site adjoining Lake Michigan, will have 7200 sq ft of floor space.

All testing equipment and machine tools, and the company's research department, will be located in the new building, which will be of concrete block construction with brick facing on three outside walls.

Gas vs. electricity

An Ohio PUC order regulating natural gas operations is under fire from two Ohio electric companies, who claim the order has discriminatory provisions.

The order provides that a standby heating system must be installed in commercial buildings which use a large amount of gas heat. But, if the system has a gas air-conditioning system, the order says that standby heating system need not be installed.

System under construction

Construction is under way on the distribution system to serve the last city in Saskatchewan without natural gas, Yorkton. Gas is expected to be in use in Yorkton by about mid-summer.

Saskatchewan Power Corp. reached more than one-third of its objective in potential customers in the city before any work had been done on the $715,000 distribution system. Early applications for service pipe numbered 500.

AMERICAN®
insulated
meter connections

permanent
molded-on design
simplifies assembly

- Insulation covers pilot flange and extends up the body—minimizes possibility of short circuits caused by moisture. No loose parts.
- Tough Nylon insulation seals tight, resists crushing. High dielectric strength eliminates electrolysis.
- Insulated meter connections are interchangeable with standard connections—accepts standard caps and washers. Reduces inventory problems.

Ask your American representative for Bulletin 308 describing all insulated and standard meter connections.

AMERICAN® METER COMPANY
INCORPORATED ESTABLISHED 1836

Executive Offices: Philadelphia 16, Pa.
Sales offices in principal cities.

MAKING THE BEST BETTER THAN EVER!

35-B IRONCASE METER

80-B 250-B 500-B

AMERICAN METER CO.

AMERICAN® METER COMPANY

INCORPORATED (ESTABLISHED 1836)

General Offices: Philadelphia 16, Pa.

Sales offices in principal cities

American® high capacity Ironcase Meters with

DURAMIC DIAPHRAGMS—molded, 3-convolution design for all fuel gas services.

REINFORCED FLAG RODS—insure positive alignment and sustained accuracy.

GROMMET SEALS—on flag rods provide minimum friction.

American high capacity Ironcase and Aluminumcase meters now incorporate these latest design advances for handling the big loads accurately and economically.

Sustained accuracy is built into these meters with the many refinements developed by American in over 120 years of meter engineering.

- Rated capacities to 10,000 cfh — 0.60 sp. gr. gas.
- Working pressures to 250 psi in rugged Ironcase meters . . . to 100 psi in light weight Aluminumcase meters.
- Valve motion and linkage, designed for minimum angularity effect, provides minimum wear and maintenance.
- Permanent steel inserts in connections of Aluminumcase models eliminate thread galling.
- Gas-tight, non-warping valves are light for minimum friction and noiseless for trouble-free service.

See Playhouse 90 on CBS-TV

GEM

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters • Instruments • Reliance Regulators • Apparatus • Valves

NEW LOOK FOR A FAMED LANDMARK —Will Rogers Memorial Park in Beverly Hills, Calif., is now decoratively lit with 14 Gaslites made by Arkla Air Conditioning Corp. The Sunset Blvd. landmark is believed to be among the first parks in the nation to become gas-lit. Building in the background is the Beverly Hills hotel.

Northwest backs state's centennial celebration

Both the State of Oregon and Northwest Natural Gas Co. are 100 years old this year. Northwest is whole-heartedly supporting the state's centennial celebration with four projects.

Three of these are in an exposition and international trade fair, which opened its three-month stand in June as the state's biggest single anniversary effort.

A showpiece dwelling with nearly 6000 sq ft of space and full of controversial features is a joint work of NNG and the Portland Home Builders Association. This Centennial Home of Ideas cost close to $200,000 furnished.

Its all-gas kitchen contains a portable peninsula-type cooking unit built by RCA-Whirlpool which can be connected to wall outlets inside or on the patio.

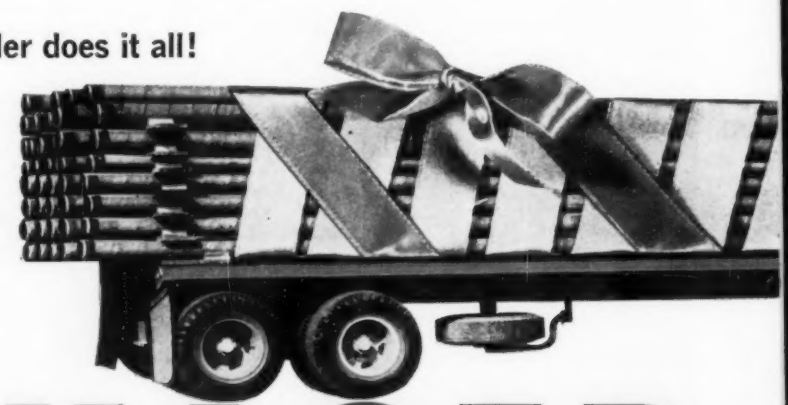
Another gas feature is an anodized turquoise-hued aluminum screen nearly 20 ft long and forming a half-circle. This 6½-ft high wall supplies either warm or cold air in the dining room and separates dining from other living areas.

As its second project, NNG has coordinated a gas industry display in the 11-acre main Centennial building. Twenty gas appliance makers and distributors, and Pacific Northwest Pipeline Corp., have filled 6000 sq ft with appliances, decorative materials, and murals.

A "flame sculpture," arching upward from a flame-shaped reflection pool, is project No. 3. A natural gas flame leaps 20 ft or more from its tip at regular times.

And, this year's homemaking contestant in the Mrs. America selections is officially designated Mrs. Oregon Centennial.

Lower costs! One purchase order does it all!



PACKAGED

NOW—A REVOLUTIONARY NEW LOW-COST CONCEPT IN PIPE BUYING

Southern Pipe PACKAGED PIPELINES offer you a brand new way to save money, cut red tape, eliminate worries. One order does it all—from pipe production and processing to trenchsite delivery. You buy one complete pipeline package, delivered when you need it.

Write for LITEWALL PACKAGED PIPELINES brochure today.

SP-26-59 © 1959—So. Pipe • Div. of U.S. Industries, Inc.

Future architect honored

First annual presentation of the F. S. Wade scholarship, planned as a yearly award to a student of outstanding promise, has gone to a Pasadena (Calif.) City College student, Thomas E. Beebe.

The $1000 scholarship was set up by Southern California and Southern Counties Gas companies to insure the winner's further study in the University of Southern California's school of architecture.

Beebe's award winning entry consisted of a large kitchen with an island arrangement for top burners and a gas-fired indoor barbecue, built-in refrigerator, two gas ovens, and a built-in dishwasher.

LILCO modernizing office

Long Island Lighting Co. is spending $225,000 to modernize its zone headquarters in Roslyn. Major project is erection of a one-story brick and block office building.

In addition to office, service, and storage areas, the 6000-sq ft building will provide space for an assembly room with a seating capacity for about 100 people.

In order to show its customers and employees the many wonders worked by modern gas service, Alabama Gas Corp. created this display and routed it to seven of the cities it serves. American Meter Gascloks show the great scientific and technological advances made by the gas industry in recent years. The Gasclok delivers more than 20 times the torque of convention spring-wound mechanisms.

PG&E extends service

Pacific Gas & Electric Co., San Francisco, plans a $467,000 extension of gas service to Rio Dell and Scotia, providing a signup of 800 or more customers can be obtained in the area.

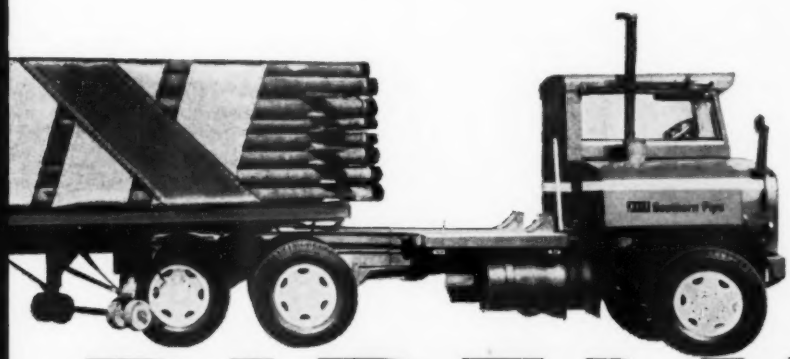
Construction of the system won't get under way until PG&E has received 800 signed applications and obtained rights-of-way. Conversions of appliances from LPG to natural gas will be made by PG&E.

Rental program success

Citizens Gas & Coke Utility, Indianapolis, one of the first gas companies to rent commercial gas water heaters, reports that in the 43 months of the program, 560 Ruud commercial units were rented. Of these, the number of removals for all reasons was 35.

Rentals were made in 19 different classes of commercial buildings.

Monthly rental fee is $9. This, together with the gas bill, is the customer's only expense. Installation, maintenance and, where necessary, removal costs are absorbed by Citizens Gas.



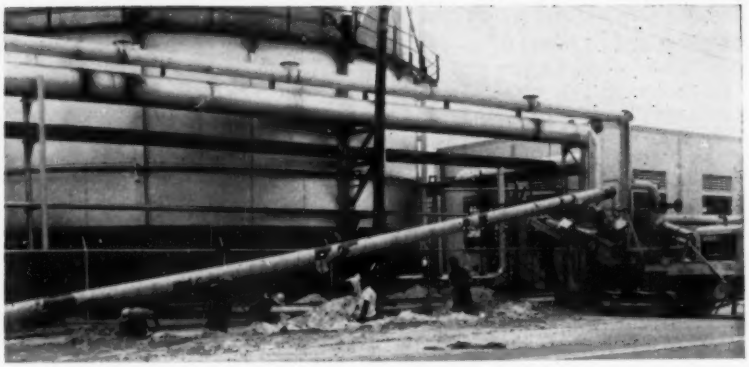
PIPELINES

SOUTHERN PIPE PACKAGED PIPELINES GIVE YOU: (1) pipe produced to your exacting specifications, (2) from steel coil in our own pipe mill, (3) cut precisely with NO random lengths, (4) coated (or lined) at our plant, (5) warehoused, if necessary, until you need it, and (6) delivered to your trenchsite ready for welding and placing in trench. **PACKAGED PIPELINES** come in API monogrammed pipe or in Southern Pipe's own LITEWALL pipe—a new high strength, lightweight pipe manufactured to API specifications. (Southern Pipe warehouses standard sizes for immediate delivery, too.)

USI Southern Pipe DIVISION OF U.S. INDUSTRIES, INC.
P.O. BOX C • AZUSA, CALIFORNIA • CUmberland 3-7111 – EDgewood 7-1221

GAS • News Notes

Washington Natural Gas Co., Seattle, is increasing its 1959 construction budget by nearly $2 million. Last fall, directors okayed a $5.6 million budget for 1959, but, reports president C. M. Sturkey, ". . . mounting demands from builders and from the public at large for additional natural gas service caused the directors later to increase the year's budget to $7,542,000."



Another Florida scene is this one—a length of 12-in pipe forming the final link between the new gas line in Florida's Sunshine Parkway and Peoples Gas System's manufacturing plant in North Miami Beach.

wherever you have
a corrosion problem . . .
Standard Magnesium
has the answer . . .
Whether it's pipelines or well casing, tanks or filters, offshore units or marine vessels, Standard Magnesium has the answer to any corrosion problem. With over 300 standard magnesium anode designs, designs that have proved their effectiveness in installation after installation, Standard Magnesium has the anode to fit any cathodic protection need.
Standard Magnesium anodes are available in either the conventional H-1 alloy anode, or the special High Current anode. High current anodes are designed for high resistance soil conditions and produce 50% greater current output than conventional anodes. Either can be supplied bare or in our exclusive Vibra-Pak package for special soil conditions.
No matter what the installation, Standard Magnesium anodes will provide better, more economical protection.
NOW AVAILABLE!
1. ADVANTAGES OF HIGH CURRENT ANODES
2. HOW TO PREVENT SEAWATER CORROSION
3. HOW TO PREVENT CORROSION OF TANKS
Send for your FREE copies today
QUALITY AND DEPENDABILITY THROUGH RESEARCH
Standard Magnesium Corporation
7500 EAST 41ST STREET — TULSA, OKLAHOMA
MAGNESIUM INGOT · MAGNESIUM ANODES · MELTING FLUX

New York State Natural Gas Corp.'s Preston station, Sycamore, Pa., has won a certificate of commendation by the National Safety Council for working 12 years without a lost-time accident. This is the best record ever accumulated by a New York Natural unit, representing 504,297 man-hours for the Preston personnel. The record was started in 1947 when construction of the station began.

The Florida senate passed a bill creating a gas transmission and distribution safety code. Under the measure, gas transmission and distribution facilities would be tested by the state PUC. Covered are safe design, installation, inspection and operation of the systems, including pipelines, stations, metering and gas mains up to the outlet of the customer's meter.

Allis-Chalmers Manufacturing Co. plans to acquire Tractomotive Corp., Deerfield, Ill., through an exchange of stock. One of Tractomotive's principal product lines is a rubber-tired wheel loader, the Tractoloader, which is sold through Allis-Chalmers dealers.

The town of Brush, Colo., approved a new 20-year gas and electric franchise for the Public Service Co. of Colorado by a vote of 782 for to 549 against.

The Oregon (Ohio) council granted Ohio Fuel Gas Co. a 10-year franchise to distribute gas and extend and maintain pipelines in the city. The franchise is the first between Oregon and OFG.

GAS ASSOCIATIONS

AGA plans mobile equipment display

Heavy duty mobile equipment in a 10-acre outdoor exhibit will highlight the AGA's 41st annual convention in Chicago Oct. 5-7.

The exhibit, conducted by the operating section, will feature the most advanced types of equipment used in the construction, maintenance and operation of gas industry facilities. The theme, "New Tools for Growth and Service," ties in with the general convention theme, "New Horizons for Growth and Service."

Special demonstrations of the equipment have been arranged for the afternoon of Oct. 6, although the exhibit will be open throughout the three-day meeting.

MacDonald joins AGA staff

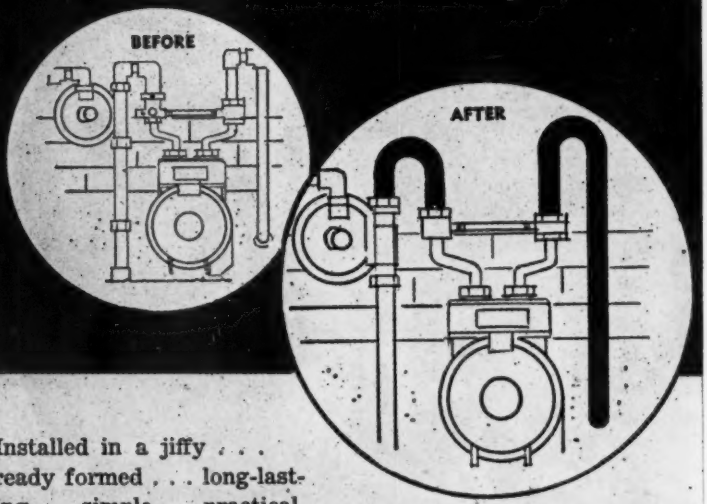
John A. MacDonald has joined the AGA Laboratories in Cleveland as assistant controller. In his new post, MacDonald will work with Controller E. L. Bangert. His work will cover the entire scope of the Laboratories' accounting activities.

W. B. Brown (center) who has attended every gas measurement short course since they were started in 1924, is shown with officials of the 1959 course, held at the University of Oklahoma recently. Brown is retiring this month as meter shop superintendent of the Gas Service Co., Wichita. With him are W. H. Carson (right), dean of the College of Engineering and chairman of the executive committee of the short course, and R. F. Nowlin, United Gas Corp. and 1959 general chairman of the course. R. R. McCafferty of Pioneer Natural Gas Co. succeeds Nowlin as chairman for 1960.

✓BRING YOUR METER CONNECTIONS UP TO DATE

PRODUCTION METER LOOPS and RISERS

• Eliminates Fittings



Installed in a jiffy . . . ready formed . . . long-lasting . . . simple . . . practical. Production Meter Loops and Risers have everything! Graceful and ready for installation anywhere. Good for years . . . good for you and your users.

- 90° and 180° bends
- ¾" - 1" - 1¼" pipe
- threaded one or both ends
- special shapes, if desired

Write for details and prices or for representative to call.

Manifolds and Supply Pipes for Gas Appliances

THE PRODUCTION PW PLATING WORKS, Inc.

LEBANON OHIO

1897 1959

PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER CO. INC.

GOODMAN USED SINCE 1897 2" HANDLE & LOCKING SLEEVE GAS MAIN STOPPER

523 Atlantic Avenue
Brooklyn 17, N. Y.
Cable Address GASTOPPER, N. Y.

To save time . . .
Every Tool Box Needs
a compact, easy-to-carry

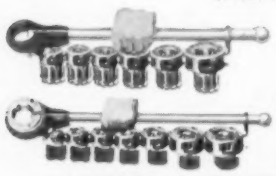
RIDGID®

Drop Head Threader Set

Snap a die head in the ratchet ring . . . cut your thread! It's as simple as that with a RIDGID drop head threader. Heads can't fall out . . . dies reverse quickly for close-to-wall threading. Finest quality RIDGID long wearing dies. Bolt and conduit dies available.

Call Your Supply House!

Hand Carrier Free With All Sets Except No. 12-R
(Order in sets or any combination)



Exposed Ratchet Type
For pipe: ⅛" to 1"—00-R; ⅛" to 1¼"—111-R; ⅛" to 2"—12-R
For bolts: ¼" to 1"—00-RB

Enclosed Ratchet Type
For pipe: ⅛" to 1"—0-R; ⅛" to 1¼"—11-R

RIDGID®
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Carl D. Rader

R. H. Lussky

Measurement course expects record crowd

A record enrollment of more than 800 gas utility, pipeline and petrochemical measurement and control engineers and technical people is expected at the 19th annual Appalachian Gas Measurement Short Course, Aug. 24-26 at West Virginia University, Morgantown.

R. H. Lussky, West Virginia Public Service Commission and program chairman of the course, said that 90 classroom, laboratory and forum sessions are scheduled. Sessions range from basic courses through shop practice and testing, installation design, monitoring equipment and other related phases of regulation and measurement.

On display will be the latest developments in the field of gas measurement and control equipment.

Carl D. Rader, Tennessee Gas Co., is general chairman of the course.

Program requests and reservation information should be directed to Prof. R. E. Hanna at West Virginia University, Morgantown, W. Va.

At the recent AGA research and utilization conference in Cleveland, W. B. Kirk of the AGA Laboratories conducted a high-speed gas cooking demonstration, using equipment which included radiant gas burners in an open oven housing. His assistant was Gretchen Conrad of East Ohio Gas Co.

Pennsylvania meeting termed "best ever"

A record-smashing attendance figure set the pace for the 51st annual convention of the Pennsylvania Gas Association held recently in the Pocono mountains. With 537 delegates streaming in from all over the Keystone state, newly elected president W. C. Pierson, of Philadelphia Electric Co., termed the meeting the most successful ever held.

Other new officers elected are: 1st vice president, E. H. Smoker, president of United Gas Improvement Co.; 2nd vice president, J. E. Geesey, president and general manager of York County Gas Co.; 3rd vice president, L. B. Richards, vice president, Harrisburg Gas Division of UGI.

Newly elected council members are John W. Carroll, general superintendent, gas transmission and distribution, Philadelphia Electric; Mervin P. Stermer, vice president, York County Gas; John L. Harrison, general manager, Lancaster County Gas Division of UGI; and William J. Foster, vice president, Geo. D. Roper Corp., Philadelphia. Incumbents remaining in office were secretary-treasurer James A. Schultz, Reading Gas Division of UGI; and managing director Frank H. Lichtenwalter.

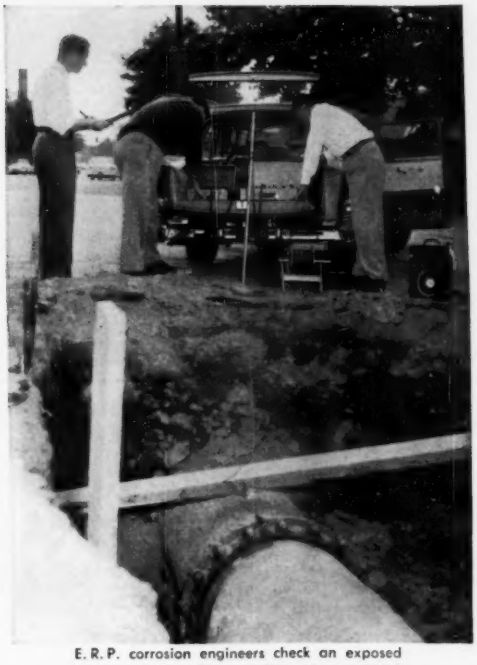
PUAA chooses new slate of officers

Newly elected officers chosen at the recent convention of the Public Utilities Advertising Association are headed by Warren Widenhofer, public relations director of Indiana & Michigan Electric Co. He succeeds outgoing president George W. Kindon of Philadelphia Electric.

Other officers are: 1st vice president, Frank C. Lietz, advertising manager, Northern Illinois Gas Co.; 2nd vice president, Jack A. Fleming, director of public relations for Canadian Western Natural Gas Co. Ltd. and Northwestern Utilities Ltd.; 3rd vice president, James Lumpp, Union Electric; secretary, Robert H. Robertson, Florida Power Corp.; treasurer, Mead Schenck, Interstate Power.

New directors: Elton E. Stuenckel, advertising manager, South Jersey Gas Co.; George Lamason, advertising and public relations, Kentucky Utilities Co.; and Norman Jacobshagen, advertising manager, Kansas Gas & Electric.

Engineering PLUS . . . makes the difference in pipeline cathodic protection



E. R. P. corrosion engineers check an exposed leak area. Here they correlate pipe potential and line current measurements for electrolysis.

It takes a lot of know-how to protect a pipeline from corrosion. That's why corrosion engineers at E.R.P. keep abreast of the latest instrumentation. Whether they are protecting an old pipeline or preventing corrosion on a new line, they use every modern method to be sure each cathodic system is as effective as possible.

That's what makes the difference in E.R.P. cathodic protection: engineering when the cathodic system is designed; when it's installed; when periodic corrosion surveys are made to check for environmental changes.

If you are looking for pipeline protection, E.R.P. is ready to serve you. For full information write for Bulletin E-47.41.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

CLIP THIS AND MAIL TODAY
if you have not subscribed to . . . GAS

GAS 198 SOUTH ALVARADO STREET, LOS ANGELES 57, CALIFORNIA
Standard Rates Apply to U. S. & Possessions

☐ Check herewith ☐ Bill me ☐ 2 years $3.00 ☐ 1 year $2.00

Name _____ Title _____
Firm _____
Street _____
City _____ Zone _____ State _____

Officers elected at the best attended session of the Southern Gas Association are (left to right): Harold W. Wahl of American Meter Co., Don W. Weir of Arkansas Louisiana Gas Co., and W. L. Lee of Atlanta Gas Light Co., directors; Frank Barragan Jr., South Atlantic Gas Co., secretary; William G. Wiegel, Lone Star Gas Co., treasurer; O. W. Clark, Southern Natural Gas Co., president; James A. Wilson, United Gas Corp., 1st vice president; D. L. Hill Jr., Western Gas Service Co., director; H. A. Eddins, Oklahoma Natural Gas Co., 2nd vice president; C. L. Nairne, New Orleans Public Service Inc., director; Minor C. Sumners, Mississippi Valley Gas Co., vice chairman, advisory council; and Dale E. Frieden, Zenith Gas System Inc., director. Not shown are, E. Clyde McGraw, Transcontinental Gas Pipe Line Corp., chairman of the advisory council, and Baxter D. Goodrich, Texas Eastern Transmission Corp., director.

THE *FINEST* FOR MODERN GAS DISTRIBUTION SERVICE

NORMAC

Insulating Couplings AND Fittings

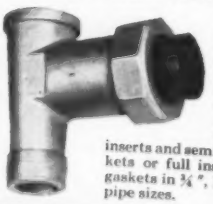
Malleable Couplings

Normac Insulating Malleable Couplings and fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets.

Malleable Service Ell

The insulating principle depicted above is carried out in all Normac Ells and Tees.

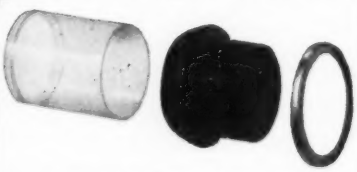
Brass Fittings



Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.

NORTON McMURRAY has specialized for 20 years in the development and production of products solely for the Gas Industry. Whether your plans include modernization, or new, expanded facilities, Normac Gas Distribution Equipment will serve you well.

Insulating Gaskets



The Normac insulating principle incorporates an efficient combination of a polyethylene sleeve and a semi-insulating gasket or full rubber gasket and retainer ring.

New CATALOG

Write for your copy . . . it gives complete details and specifications of NORMAC equipment.

NORTON-McMURRAY Manufacturing Co.

919 North Michigan Avenue

CHICAGO 11, ILLINOIS

Couplings • Meter Bars • Sleeves • Cocks • Ball Joint Clamps • Service Tees and Ells

GAMA announces new members

Several companies joined Gas Appliance Manufacturers Association recently.

New member of the gas boiler division is the Aldrich Co., Wyoming, Ill. The Airtemp Division of Chrysler Corp., Dayton, Ohio, has joined the gas furnace division. New members of the industrial gas equipment division are the Flynn Burner Co., New Rochelle, N. Y., and Protection Controls Inc., Chicago.

Morgan heads group

Donald C. Morgan, assistant vice president and products manager for gas products, Rockwell Manufacturing Co., is chairman of the gas meter and regulator division of GAMA.

He succeeds Thomas J. Watt, advertising manager of Sprague Meter Co., who was elected to the GAMA executive committee.

GAS·PEOPLE

Hugh C. Daly
American Natural

V. M. Thompson
ALG

HUGH C. DALY has been elected to the board of directors of the American Natural Gas Co. Daly has been executive vice president of Michigan Consolidated Gas Co. since 1956.

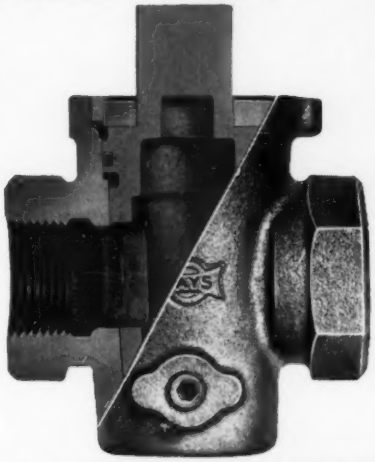
VANCE M. THOMPSON, Arkansas businessman, is a new member of the board of directors of Arkansas Louisiana Gas Co. He succeeds ROBERT S. DAVIS of St. Paul, who resigned. Two of Thompson's sons serve as directors of subsidiary companies of ALG.

GILBERT T. BOWMAN, assistant vice president of Rockwell Manufacturing Co.'s meter and valve division, has been elected a vice president of the company. He will head the international division and petroleum and industrial division. Bowman joined Rockwell in 1940 as a meter and valve sales engineer in northern California. He became San Francisco district sales manager in 1945, sales manager-gas products and Nordstrom valves in 1952, and general products manager two years later. He was promoted to his most recent post in 1956. Rockwell also announced the appointment of HUGH C. NEWTON as assistant director of public relations. Prior to joining Rockwell early this year, Newton was Rock-

G. T. Bowman
Rockwell

H. C. Newton
Rockwell

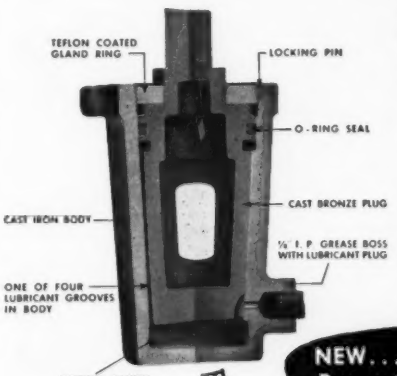
THIS GAS STOP WILL *NOT STICK...*



- A newly designed HAYS Lubricated and Tamper-Proof Gas Stop . . .
- Stop is completely lubricated at the factory . . .
- Four Grooves in body, and Lubricant Plug provide for pressure re-lubrication . . .
- Locking Pin positively prevents tampering at top of stop . . .
- O-Ring prevents top leakage . . .
- Teflon Coated Gland Ring reduces friction between top of plug and gland ring...

Re-Lubrication does the *TRICK*

HAYS
LUBRICATED TAMPER-PROOF SAFETY GAS STOP*



- Lower initial and turning torque . . .
- Extra grade gray iron body, gas service bronze plug . . .
- Individually tested . . .
- Black or Galvanized, Flat Head or Lockwing Pattern...
- Sizes: ¾", 1", 1¼", 1½", 2", for 125 psi. W. P.

Write for Folder 121 and prices.

*Patent applied for.

NEW... Solid Bottom Construction Prevents Leakage and Tampering

HAYS®
GAS SERVICE PRODUCTS
HAYS MANUFACTURING CO.
ERIE, PA.

well's PR representative as an account executive for Burson-Marsteller Associates.

GORDON P. OSLER has been elected president of Greater Winnipeg Gas Co. Osler, a director of the company for the past year, also is president of the investment firm of Osler, Hammond & Nanton Ltd. He succeeds R. D. GUY, who is continuing as a director of Greater Winnipeg. Other officers elected were: A. R. ELLIOTT, vice president and general manager; F. BANCROFT, vice president and secretary treasurer; and MISS F. GIBB, assistant secretary. H. C. NEAL was named sales manager. He was formerly division sales manager of Union Gas Co. of Canada at Windsor.

D. G. SHINGLEDECKER has been promoted to mainline superintendent of New York State Natural Gas Corp., Pittsburgh. He joined New York Natural in 1952 as head engineer in its southern division. Most recently he has been assistant superintendent in the central division at Jacksonville, Pa. New York Natural also announced the appointment of J. A. LOCKARD as superintendent of warehousing.

FRED J. HAGY JR., manager of the Waterloo, Iowa, branch of the A. Y. McDonald Mfg. Co. for the past 11 years, has been promoted to merchandising manager. He will supervise all branch operations, and will act as liaison between the branches and the home office in Dubuque.

Edward A. Holmberg, advertising manager of Consolidated Edison Co. of New York, receives his 50-year service pin from board chairman Harland C. Forbes. Holmberg joined Edison Electric Illuminating Co. of Brooklyn (forerunner of Brooklyn Edison and long since merged into Con Edison) in 1909. He began as office boy in advertising, was quickly shunted into sales work. Eight years ago, he returned to advertising to sit in the manager's chair.

MARTIN B. JAEGER has been named to the newly created post of advertising manager for Koehring Co., Milwaukee. Jaeger formerly was manager of advertising and publicity for Bucyrus-Erie Co.

MILTON W. HEATH JR. has been elected a vice president of Heath Survey Consultants Inc., Wellesley, Mass. BARBARA M. VAUGHAN succeeds him as home office manager.

CHARLES W. KRAUSE has been promoted from eastern regional sales manager of Neptune Meter Co. to general sales manager for all the company's liquid meters. JAMES C. JUDGE succeeds Krause. Other appointments include G. W. MOORE, Philadelphia district manager; JOHN J. MORAN, sales representative in upstate New York.

GLENN A. LONG has been promoted from assistant service manager to service manager of Sherman Products Inc., Royal Oak, Mich.

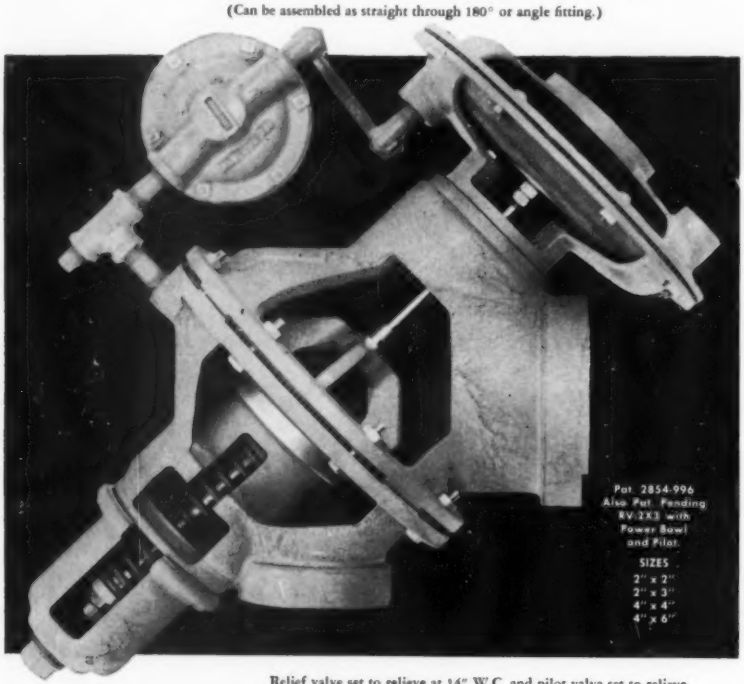
Safety PLUS PERFORMANCE

A Pilot Operated Relief Valve that will not fail to open because of pilot failure.

With Power Bowl and/or Pilot Relief Valve improves performance with less increase in pressure for same capacity.

Power Bowl available up to 15 pounds—maximum inches W.C. to 50 pounds.

(Can be assembled as straight through 180° or angle fitting.)



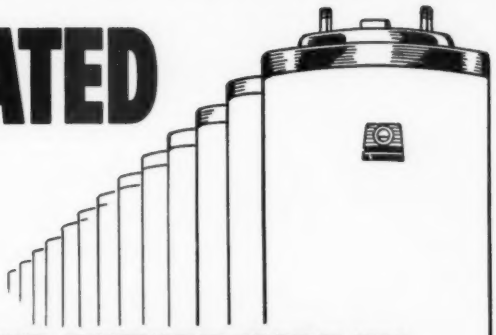
Relief valve set to relieve at 14" W.C. and pilot valve set to relieve at 14" W.C.—when pressure is increased to 24" W.C. capacity of relief valve is 24,000 cu. ft. one hour.

If pilot valve fails the relief valve will operate and pass the same capacity but at a pressure of 1.5 PSI—without the power bowl the same capacity will require 3 PSI outlet.

REYNOLDS GAS REGULATOR CO., INC. Anderson, Indiana

A Subsidiary of Arkansas Louisiana Gas Company

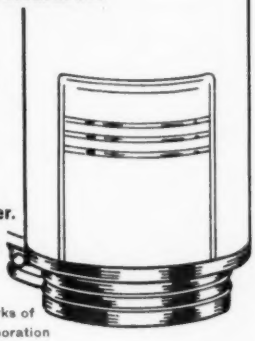
ONLY THE FINEST WATER HEATERS ARE PERFORMANCE RATED



...AND THEY'RE MADE BY AMERICAN-STANDARD

FINEST NAME IN PLUMBING AND HEATING

- With Performance Rating you easily match your customer's needs to the right size "rated" water heater.
- Performance Rating quickly makes you the water-heater expert; gives you quality and service to sell.
- Performance Rating means your customers won't run out of hot water.
- Glass-lined or galvanized steel tank; 20 to 65 gallons; full price range.



American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation

American-Standard Products

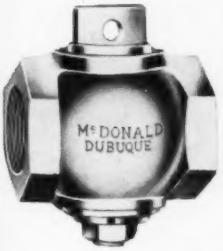
AMERICAN-Standard

PLUMBING AND HEATING DIVISION

McDONALD

THE QUALITY NAME IN GAS SERVICE STOPS

For dependable performance, you can rely on McDonald Gas Service Stops. Engineering skill and over 100 years of manufacturing experience are your assurance of the very highest quality. Look for McDonald next time you buy. It's the quality name in Gas Service Stops.



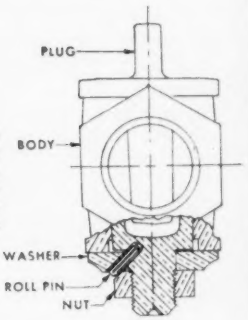
10693

Gas Service Stop. Iron Body. Flat Way. Heavy Pattern. Flat Head with Bronze Plug, Nut and Washer. With Shur-Lock Feature. Black or Galvanized.

Size Inches: ½, ¾, 1, 1¼, 1½, 2.

ROLL PIN LOCKS: PLUG, WASHER, NUT

Line Drawing illustrates the Shur-Lock Feature. Roll Pin Locks Stem Nut Preventing Unauthorized Removal or Adjustment. For Stops With This Feature, Specify Number 10693 or 10694.



10694

Gas Service Stop. Iron Body. Flat Way. Heavy Pattern. Flat Head Lock Wing, with Bronze Plug, Nut and Washer. With Shur-Lock Feature. Black or Galvanized.

Size Inches: ½, ¾, 1, 1¼, 1½, 2.

For information on the complete line of McDonald gas service stops, write for free catalog.

Over a Century of Service — McDonald — Yesterday Today Tomorrow

A.Y. McDONALD MFG. CO.

Dept. G-759, 12th & Pine

DUBUQUE, IOWA

ELIMINATE
MAJOR REPAIRS
WITH
AMERICAN®
WELDED
STEELCASE METERS

- Tinned Steelcase Accuracy
- Hardcase Durability
- Maintenance Economies

American Welded Steelcase Meters provide a new approach to the economics of meter maintenance and retirement. Major repairs are eliminated. Minor adjustments are easy to make – assuring long service life at lowest maintenance costs.

Ask your American Meter representative for full details about Welded Steelcase Meters and their many advantages for all fuel gas services.

W-75	Rated cap. 75cfh — FOB Philadelphia
W-175	Rated cap. 175cfh — FOB Fullerton, Cal.
W-210	Rated cap. 210cfh — FOB Philadelphia
W-250	Rated cap. 250cfh — FOB Philadelphia
W-300	Rated cap. 300cfh — FOB Philadelphia
W-45-LPG	Rated cap. 45cfh* — FOB Philadelphia
WC-45-LPG	Rated cap. 45cfh* — FOB Philadelphia

*propane

Rated capacities at ½-inch w.c. differential with 0.64 sp. gr. gas — 5 psi working pressure.

AMERICAN®
METER COMPANY
INCORPORATED ESTABLISHED 1836

General Offices:
Philadelphia 16, Pa.

Sales offices
in principal cities

The new post of assistant to the executive vice president of Dresser Industries Inc. is being filled by CARL J. MAKI, formerly of the Texas Co. In his new post, Maki will work on engineering developments in gas applications. At the Texas Co. he was assistant to the manager of the gas division. Dresser has appointed JAMES R. BROWN JR. as director of manufacturing. Brown comes to Dallas from the Baldwin-Lima-Hamilton Corp., where he was works manager. At Dresser, Brown will be a member of the headquarters staff and be responsible for evaluating manufacturing process and procedures, analyzing the capital expenditures program, and making recommendations in general business areas having to do with manufacturing among the Dresser companies.

HAROLD N. ROBINSON has joined Robertshaw-Fulton Controls Co., Richmond, Va., as chief internal auditor.

C. SIDNEY JOHNSTON has joined the Norge Division of Borg-Warner as midwestern division gas utility manager. He will headquarter in Chicago and cover 11 states.

G. J. TANKERSLEY, president of Western Kentucky Gas Co., Owensboro, Ky., has been elected a member of Arkla Air Conditioning Corp.'s board of directors.

LOGAN D. WILSON, manager of Lone Star Gas Co.'s Lancaster district, has been named district manager at Hillsboro. He succeeds J. HENRY DUKE, who is retiring.

GUY MATHENY has been appointed superintendent of mainlines for the Peoples Natural Gas Co., Pittsburgh. He has been with the company for 35 years.

JAMES P. JACKSON and ALBERT W. FINLY have been appointed as-

Carl J. Maki
Dresser

J. R. Brown Jr.
Dresser

WARRENGAS
the Concentrated Fuel
GULF GULFTANE LP-GAS BUTANE PROPANE
WARREN
PETROLEUM CORPORATION
LIQUEFIED PETROLEUM GAS DIVISION
TULSA, OKLAHOMA
SALES OFFICES:
FORT WORTH, TEXAS
HOUSTON, TEXAS
LOUISVILLE, KENTUCKY
MIDLAND, TEXAS
JACKSON, MISSISSIPPI
ST. LOUIS, MISSOURI
NEW YORK, NEW YORK
OMAHA, NEBRASKA
COLUMBIA, SOUTH CAROLINA
TAMPA, FLORIDA
LOS ANGELES, CALIFORNIA
BRYN MAWR, PENNSYLVANIA

for leakproof, pressure-tight connections
use TiteSeal®
SEALING COMPOUNDS
Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.
BRUSH-ON TiteSeal LIQUID TYPE NON-HARDENING GASKET & JOINT SEALING COMPOUND
7 BASIC BLENDS

LIQUID WRENCH®
The super-penetrating rust solvent
DEODORIZED Liquid WRENCH
LOOSENS
rusted bolts, nuts, screws, 'frozen' parts
Liquid Wrench works fast ... yet is absolutely safe for all metals and alloys.
2171
At Industrial, Automotive, Hardware, Plumbing Jobbers
SOLDER SEAL
RADIATOR SPECIALTY CO.
Charlotte, North Carolina

K. F. Williamson
Grove

J. T. Self
City Gas

sistant controllers of Michigan Consolidated Gas Co., Detroit. Jackson has been chief accountant since 1950; Finly was formerly assistant to the controller.

WILLIAM O. OWEN has been named assistant to the president and manager of the industrial furnace division of Natural Gas Equipment Inc., Pasadena, Calif.

Three officers of Midwest Piping Co., St. Louis, have received appointments as vice presidents. They are: T. R. TAYLOR JR., formerly manager, eastern division; E. B. STOLLE, formerly manager, Pacific division; and NORMAN B. CHAMP JR., formerly assistant to the president.

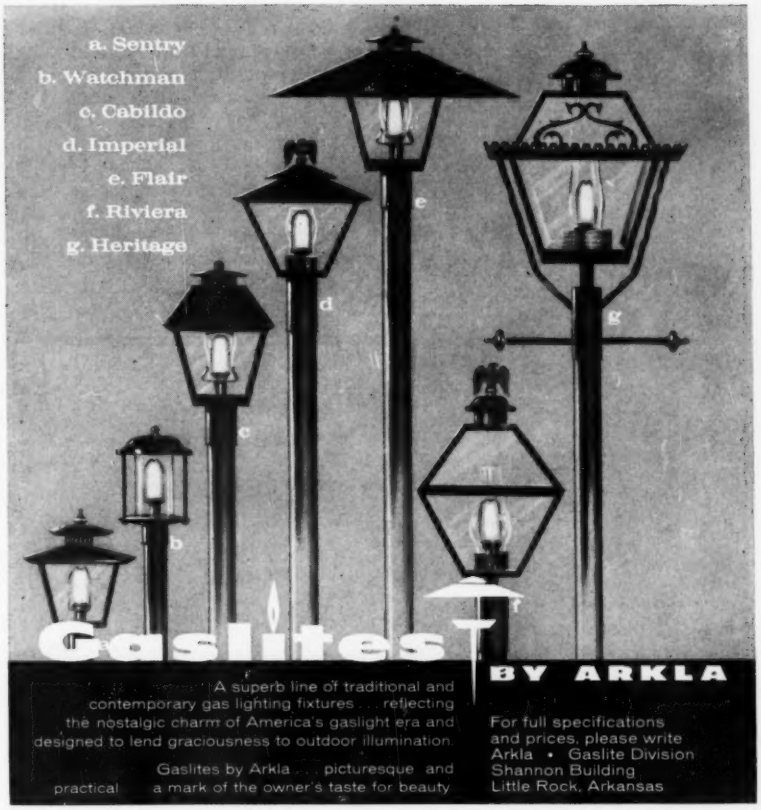
DAN L. MAYER has been promoted to manager of Phillips Petroleum Co.'s natural gas department. R. B. STEWART held this post until his promotion to vice president, natural gas.

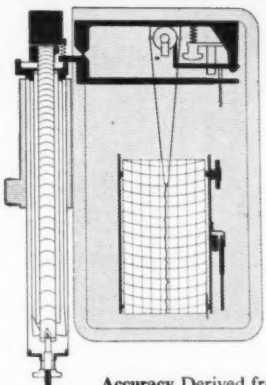
J. T. SELF has joined City Gas Co., Miami, Fla., as assistant general manager. For nearly 20 years, Self was an official with the South East Public Service Co.'s natural gas division of Charleston, W. Va. He served as assistant general manager in charge of production, distribution, and transmission in parts of Kentucky, West Virginia, and Ohio.

KENNETH F. WILLIAMSON has joined Grove Valve & Regulator Co., Oakland, Calif., as assistant sales manager. Prior to joining Grove, Williamson was sales coordinator for W-K-M.

WILLIAM P. WOODWARD is the newly appointed local manager at Delhi for Union Gas Co. of Canada Ltd. New local manager at Rowan is GEORGE W. STEWART.

J. F. LEE is director of sales for Effingham county, Ga., for the Savannah Gas Co.


a. Sentry
b. Watchman
c. Cabildo
d. Imperial
e. Flair
f. Riviera
g. Heritage
Gaslites
BY ARKLA
A superb line of traditional and contemporary gas lighting fixtures . . . reflecting the nostalgic charm of America's gaslight era and designed to lend graciousness to outdoor illumination.
Gaslites by Arkla . . . picturesque and practical a mark of the owner's taste for beauty
For full specifications and prices, please write
Arkla • Gaslite Division
Shannon Building
Little Rock, Arkansas



Sigma Calorimeter

ACCURATE, DEPENDABLE

LOW IN COST

Calorific values of all combustible gases from 80 B.T.U.'s and up are read and recorded by the Sigma Mark II Recording Calorimeter. Its economy and performance are unmatched by any other similar instrument.

Accuracy Derived from a unique but simple design. Provides immediate and automatic compensation for wide variations in specific gravity, temperature and atmospheric pressure.

Low Cost Initial cost is extremely low. Compare it. Maintenance is negligible. Drive mechanism is fully jeweled. No other continuously moving parts to wear out. Serviced quickly by unskilled personnel.

Highly Adaptable Records calorific value of natural gas, coke-oven gas, producer gas, blast furnace gas, water gas, L-P gas, coal gas, and many others. Suited for wall or panel mounting. Takes little space. With special equipment can also record between 0-80 B.T.U.'s.

Write For More Information

COSA *National Representatives for Sigma Instrument Co., England*

Cosa Corporation, 405 Lexington Avenue, New York 17, N. Y.

Find it faster with FISHER!

M-SCOPE PIPE FINDER only $189.50

- Greatest depth penetration
- Greatest tracing distance
- Pinpoint accuracy
- One year between battery changes
- Built-in battery testers
- 90% less maintenance costs

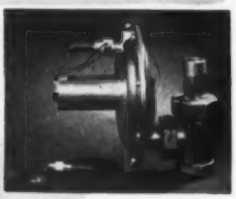
Built for rugged field use; Transistorized circuits, compact fiberglass case.

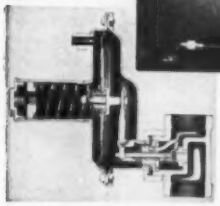
SEND FOR FREE 1959 CATALOG

FISHER Research Lab., Inc.
Dept. G-3, Palo Alto, Calif.

UNIVERSAL
GAS SERVICE REGULATORS FOR CONVERSION OR PRESSURE ELEVATION

A REGULATOR, BREATHER VENT AND CATHODIC INSULATOR IN ONE PACKAGED UNIT





U. S. Patent No. 2,577,480. Other Patents Pending.

TYPE 51-R FOR EVERY INSTALLATION

EXCLUSIVE FEATURES NOT FOUND ELSEWHERE!

Exceptionally high relieving capacity obtained by new type internal relief valve. Remarkable by-pass check valve prevents over-shooting of low pressure and damage to meter.

SEND FOR BULLETIN NO. 521

UNIVERSAL
CONTROLS CORPORATION
P. O. BOX 13122 WALNUT HILL STA.
DALLAS 20, TEXAS

ROY W. GRONAUER is the new sales manager of industrial fittings for Clayton Mark & Co., Evanston, Ill. He succeeds T. BRUCE COX, who resigned recently . . . JOSEPH H. HOFF has joined the Payne Co., La Puente, Calif., as factory district manager. He will play a major role in coordinating the sales program of the company's new gas-fired air conditioning equipment . . .

Use the Heath "V" Type Survey to locate leakage

in your residential and rural areas. This Vegetation and Soil Survey gives you maximum SAFETY, plus a 3rd party Audit of your system.

Thousands of miles of American gas lines use Heath Leakage Control Surveys annually. Write for information about a "V" Type Heath Survey for your properties.

The Safety Service That Saves Gas

HEATH
Survey Consultants, Inc.
378 Washington St., Wellesley Hills 81, Massachusetts

WANTED
Gas Superintendent

Natural gas distribution company in Pennsylvania needs competent superintendent to direct gas distribution, sales, and service. Approximately 4,000 meters. A growing business in an attractive community. Reply stating age, education, experience, and salary range.

Reply to Box 759,
GAS Magazine,
198 S. Alvarado St.,
Los Angeles 57, Calif.

The R. W. STAFFORD CO.
GAS CONSULTANTS—ENGINEERS—CONSTRUCTORS

Natural Gas Conversions
Plant Management and Operation
Peak Shaving and Standby Plants
Accident and Insurance Investigations

EVANSTON, ILLINOIS
2944 Grant St. — Phone UNiversity 4-6190

HOWARD D. HARTOUGH is the newly elected president of the Chemical Products Division of Chemetron Corp.

Bailey Meter Co.'s new East Orange, N. J., sales office is headed by H. C. WHEATON, who also manages the company's New York district office . . . THOMAS EVANS has been elected chairman and chief executive officer of the Crane Co., Chicago. L. H. T. CLEGG, for many years president of Crane's Canadian subsidiary, has been named acting president of the parent company filling the vacancy created by the resignation of NEELE E. STEARNS . . . THOMAS H. SCHWESINGER is the newly appointed manager of the east central division of Cribben & Sexton Co., Chicago.

Dixie Products Inc., has appointed WILLIAM N. AUSTIN director of marketing . . . GEORGE W. SNELL is sales administrator for the Norge Division of Borg-Warner Corp. with headquarters in Chicago . . . Newly elected vice presidents of J. I. Case Co. are: D. A. BECKENBAUGH, sales and manufacturing administrator; JACK L. BUSH, controller; GORDON A. MCMILLAN, director of Canadian operations; DAVID A. MILLIGAN, head of the industrial division; and FRANK J. PALERMO, in charge of the company's 8-plant diversified manufacturing operations.

Deaths

ANDREW F. CASSIDY, national manager of marketing for the Rheem Manufacturing Co., Chicago, died recently of a heart attack. He was 43. He joined Rheem as a sales assistant in 1945, becoming national manager of marketing in January 1957.

WALTER H. FULWEILER, who spent a notable career in the gas industry, died a few months ago at the age of 78. From 1901 to 1936, Mr. Fulweiler held various posts with the United Gas Improvement Co. or its subsidiaries. In 1907 he joined UGI's department of tests and held the posts of chief chemist, chemical engineer, and consulting chemist. Since 1936 he has been in consulting practice. Among honors bestowed on him during his long career: the AGA's Beal Medal in 1908 and 1934; the Grasselli Medal by the Society of Chemical Industry in 1922; and the Silver Medal, Sesqui Centennial International Exposition in 1926.

GAS

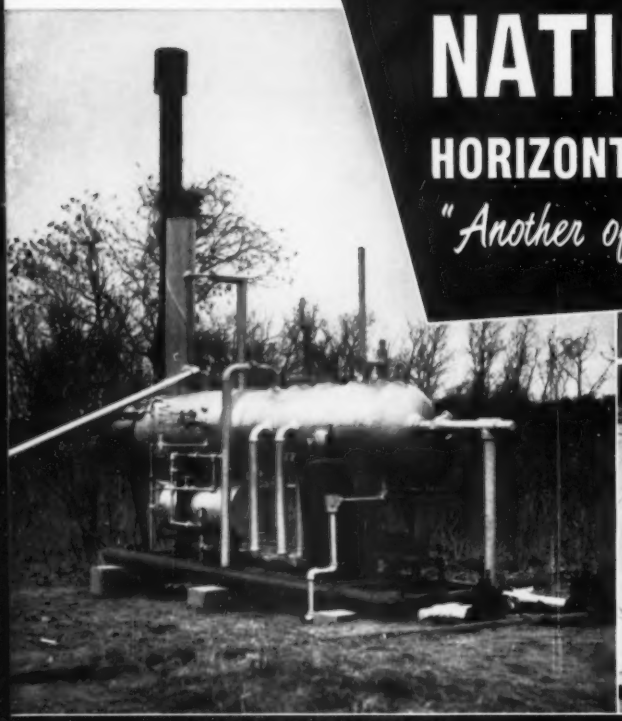
PIPELINE SECTION

Universal Pressure distribution in gas pipelines

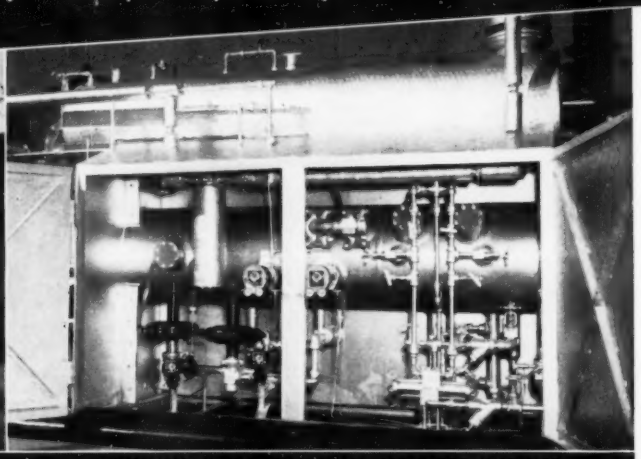
NATIONAL® *All New*

HORIZONTAL GLYCOL DEHYDRATION UNIT

"Another of Many Originals from National"



UNIT WITH INLET SCRUBBER ON STREAM NEAR OKLAHOMA CITY



WINTERIZED UNIT WITH 3-PHASE SEPARATOR INSTALLED NEAR FARMINGTON (Featuring a National Flame Arrestor)

PATENTED AND PATENTS PENDING

FEATURING:

- National Vari-Flo glycol trays
- National valves and controls
- Heat exchanger in skids
- Mist extractor on inlet to remove hydrocarbons before glycol contact
- Anti-down draft stack head
- National flame arrestor — eliminates all fire hazards
- Compactness
- Pre-piped
- Automatic
- Shop hook-up
- Shop insulated
- Ready for immediate service on delivery to your lease after well and pipeline tie-in
- National field service by trained engineers

National Vari-Flo horizontal glycol trays are more efficient than conventional trays now in use due to elimination of dead spots and non-channeling of glycol.

The glycol pump splits the flow into two equal streams of freshly concentrated glycol into the two horizontal trays.

The stainless steel removable Vari-Flo caps are a result of concentrated research in National's Laboratory. The caps are designed as a combination of the best features of the sieve tray and bubble cap but without the limitations of either.

The gas-glycol contact is automatically controlled according to the volume of gas going through the caps, thus permitting high contact efficiency at low as well as high flow rates.

Split flow contactor trays are "Another of Many Originals by National."

Dewpoint depressions have been obtained as high as 85° and 90° using New Hi-Dry Liquid Desiccant and depressions better than 75° using other glycols.

Depressions of 95° to 110° on four tray units using New Hi-Dry Liquid Desiccant.

Standard units in capacities of 2, 4, 6, 10, 15, 20, 30 and 40 MMCFD. Special sizes made to order.

Contact your nearest National Tank Company representative for more detailed information.

It's a National®

NATIONAL TANK COMPANY

DRAWER 1710

TULSA, OKLAHOMA

A universal pressure distribution curve has been developed for gas pipelines. Use of the procedure permits one to make more accurate gas pipeline computations than has been practical heretofore. A method has been devised for integrating the horizontal gas flow equation which results in general curves showing the pressure distribution for all pipeline systems for values of reduced pressure from near 0.01 to 15.0 P_r and values of reduced temperature from 1.05 to 3.00 T_r.

GAS exclusive

Universal pressure distribution in gas pipelines

By D. O. ATKINSON* and PAUL B. CRAWFORD

Texas Petroleum Research Committee, A&M Division, College Station, Texas

THE transmission of gas at higher pressures has emphasized the need for analytical procedures which would permit one to calculate the flow of gas in long horizontal lines. While the equations describing gas flow have been available for many years, it has not been practical until recently to take a rigorous account of the effects of changes in gas compressibility as the gas flows through the line[1, 2]. Recently, Nisle and Poettman[3] presented a procedure which does account for changes in the gas compressibility. The purpose of this work is to show how the gas flow equation may be rearranged and integrated to give simple and general solutions to flow problems.

The classical equation describing the isothermal flow in gases in horizontal pipes is expressed, in engineering units, as:

$$\int_{P_{r_2}}^{P_{r_1}} dP_r = \left[\frac{QP_o}{1986.5\ Z_oT_oP_c}\right]^2 \left[\frac{fGT_c}{D^5}\right] \int_{L_2}^{L_1} \frac{ZT_r}{P_r}\, dL \quad (1)$$

And for finite differences may be written as follows:

$$P_r = \left\{ \left[\frac{QP_o}{1986.5\ Z_oT_oP_c}\right]^2 \left[\frac{fGT_c}{D^5}\right] \Delta L \right\} \left(\frac{ZT_r}{P_r}\right) \quad (2)$$

Where Q = rate of flow in Mcfd at standard conditions
P_o = standard pressure, psia
T_o = standard temperature, °R
P_c = pseudo critical pressure, psia
T_c = pseudo critical temperature, °R
D = pipe i. d., feet
L = pipe length, feet
G = gas specific gravity referred to air
P_r = pseudo reduced pressure
T_r = pseudo reduced temperature
Z_o = gas compressibility factor at standard conditions
Z = gas compressibility at P_r and T_r
f = friction factor, obtained from *Fig. 7**

In the event the inlet and outlet are at different elevations, a term is added to include weight of the column of gas equal to the elevation differences.

By setting the terms in the braces { } equal to 0.001 equation (2) may be integrated in terms of reduced temperatures and pressures. The resulting plot of P_r versus the cumulative number of integrations provides a general curve which shows the pressure distribution in pipelines. Equation (3) was integrated from P_r near 0.01 to 15 for various values of T_r. The results are shown plotted in *Figs. 1-5*.

$$\Delta P_r = 0.001 \left(\frac{ZT_r}{P_r}\right) \text{ or } \Delta M \left(\frac{ZT_r}{P_r}\right) \quad (3$$

Where:

$$\Delta M = \left\{ \left[\frac{QP_o}{1986.5\ Z_oT_oP_c}\right]^2 \left[\frac{fGT_c}{D^5}\right] \Delta L \right\} = 0.001 \quad (4)$$

If other factors are known, the pipe length increment ΔL may be obtained by equation (5).

$$\text{Now, } \Delta L = \frac{0.001}{\left[\frac{QP_o}{1986.5\ Z_oT_oP_c}\right]^2 \left[\frac{fGT_c}{D^5}\right]} \quad (5)$$

* Mr. Atkinson is now petroleum engineer supervisor for Magnolia Petroleum Co. in Lindsay, Okla.

* For convenience, curves of f and $\frac{1}{f}$ as functions of Reynold's Number are included.

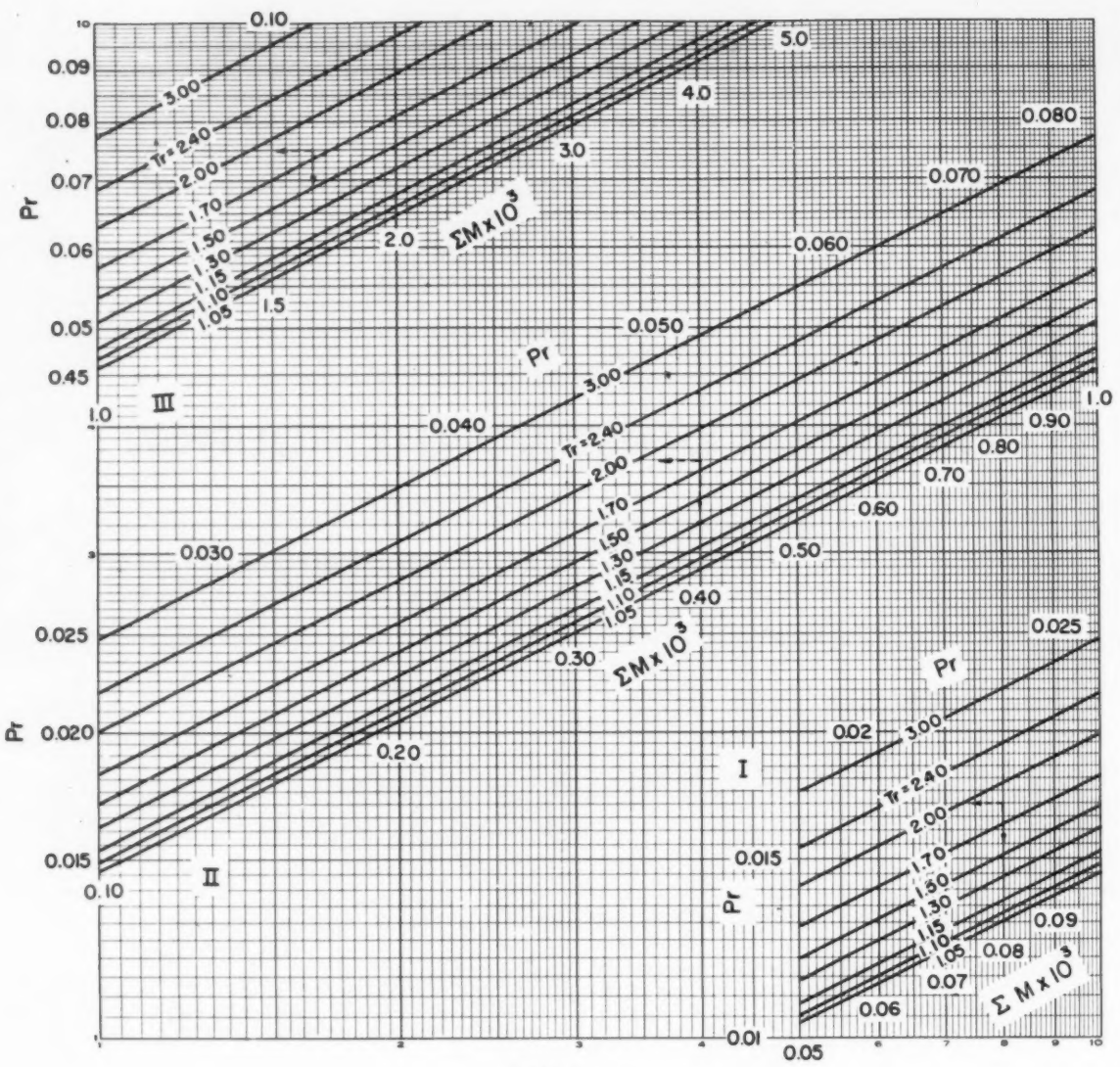


FIGURE 1.

The number of integrations which must be performed for a given pipe is equal to the total pipe length divided by the increment or:

$$\Sigma M' = \frac{L}{\Delta L} \qquad (6)$$

Where L = total length of line

ΔL = increment of line over which calculations for $\Sigma M'$ were made.

Therefore:

$$\Sigma M' = \left[\frac{QP_o}{1986.5\ Z_o T_o P_c}\right]^2 \left[\frac{fGT_c}{D^5}\right] \left[\frac{L}{0.001}\right] \qquad (7)$$

or

$$.001\ \Sigma M' = \Sigma M = \left[\frac{QP_o}{1986.5\ Z_o T_o P_c}\right]^2 \left[\frac{fGT_c}{D^5}\right] L \qquad (8)$$

Values of P_r for ΣM up to 100,000 have been calculated and are shown plotted and tabulated in this report.

Application

• ***A. Unknown flow rate***

In the case of a problem in which all the factors but the flow rate are known, it is a simple matter to calculate the flow rate by determining the values for "M" at the upstream and downstream pressures.

Now, from equation (8):

$$\Sigma M = \Sigma M_1 - \Sigma M_2 = \left[\frac{QP_o}{1986.5\ Z_o T_o P_c}\right]^2 \left[\frac{fLGT_c}{D^5}\right] \qquad (3)$$

As in all flow problems, it is first necessary to estimate a value for f (where f is read from *Fig. 7*), and then solve equation (8) for the flow rate, Q. This friction chart was obtained by Smith, Miller and Ferguson[4]. The value for f at this flow rate may then be determined, and if it is different from the estimated value, the above procedure is repeated, using the new value of f, etc., as follows:

Example I — *Unknown flow rate*

Known Conditions

$L = 200$ miles

$T = 50°$ F

$T_o = 60°$ F

$P_o = 14.65$ psia

$P_1 = 1500$ psia

$P_2 = 500$ psia

$D = 13.250$ in.

$= 1.104$ ft

$G = 0.697$

$P_c = 671.3$ psia

$T_c = 396.7°$ R

$$T = \frac{460 + 50}{396.7} = \frac{510}{396.7} = \underline{1.286}$$

$$P_{r_1} = \frac{1500}{671.3} = \underline{2.234}$$

$$P_{r_2} = \frac{500}{671.3} = \underline{0.745}$$

TABLE 1—Gas Composition

Components	*Mol. Fr.*	*Mol. Wt.*	P_c	T_c
Methane	.80	16	673	344
Ethane	.10	30	712	549
Propane	.10	44	617	666

Now, from *Table I*, $\Sigma M_1 = \Sigma M$ at $P_r = 2.234$, $T_r = 1.286$.

Since these values cannot be read directly, straight line interpolation is used from which it is found that $\Sigma M_1 = 2.932$.

The same process is repeated to determine $\Sigma M_2 = \Sigma M$ at $P_r = 0.745$, $T_r = 1.286$ or $\Sigma M_2 = 0.253$.

Substituting in equation (8):

$$\Sigma M = \Sigma M_1 - \Sigma M_2 = 2.932 - 0.253$$

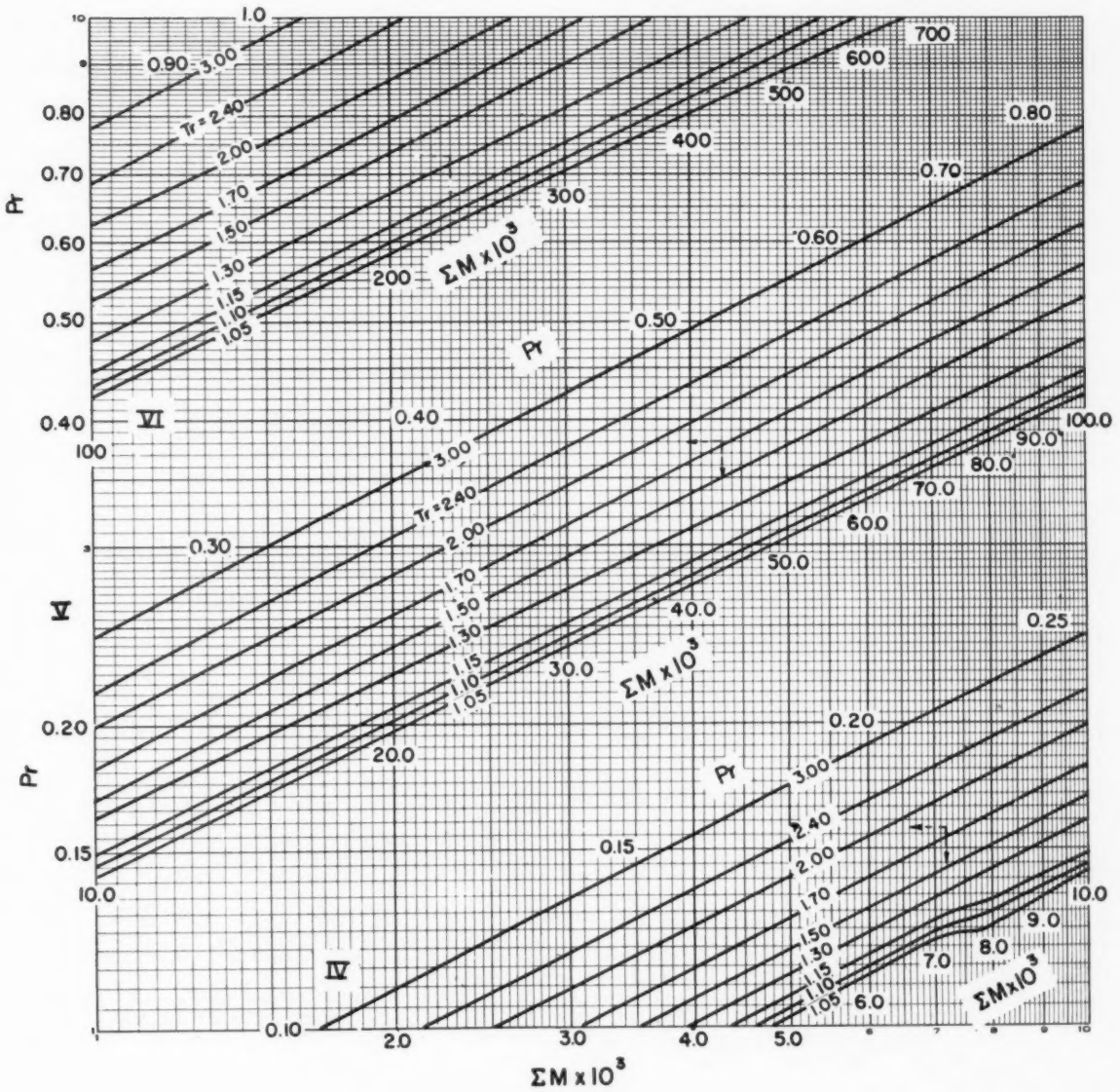


FIGURE 2.

$$= 2.679 = \left[\frac{Q^2 P_o^2 fLGT_e}{(1{,}986.5)^2 Z_o^2 T_o^2 P_e^2 D^5}\right]$$

$$Q = \sqrt{\frac{(2.679)(1{,}986.5)^2 (Z_o)^2 (T_o)^2 (P_e)^2 D^5}{P_o^2 fLGT_e}}$$

$$= \sqrt{\frac{(2.679)(1{,}986.5)^2 (1)^2 (520)^2 (671.3)^2 (1.104)^5}{(14.65^2)(1{,}056{,}000)(0.697)(396.7)\,f}}$$

$$= \sqrt{\frac{33.713 \times 10^6}{f}}$$

In order to make a first estimate of f, the friction factor, we must estimate a value for Reynold's Number, R. Generally, the first estimate can be made in the turbulent or flat portion of the f curve. As a first estimate of f, the value for Reynold's Number, R, will be taken as 10^8. This gives a reading for f = 0.00265.

Now,

$$Q = \sqrt{\frac{33.713 \times 10^6}{0.00265}} = \sqrt{\frac{3.3713}{2.65}} \times 10^5$$

$$= \sqrt{1.2722 \times 10^5}$$

$$= 1.1279 \times 10^5 = 112{,}790 \text{ Mcfd}$$

In order to check the selection of f, the Reynold's Number, R, $= \frac{DV\rho}{\mu}$ must be calculated for this flow rate.

$$R = \frac{DV\rho}{\mu}$$

Where:

D = pipe i. d. in ft

V = gas velocity in ft/sec $= \frac{Q}{A}$

ρ = gas density in lb/ft³

μ = gas vis.[2] in lb/ft sec

= (0.000672) (μ in cp.)

$$R = \frac{DQ\rho}{A\mu}$$

$$= \frac{(1.104 \text{ ft.})\left(\frac{11.279 \times 10^7 \text{ ft}^3}{24 \times 3600 \text{ sec.}}\right)(\rho \text{ lb/ft}^3)}{\left[\frac{\pi}{4}(1.104)^2 \text{ ft}^2\right]\left[0.000672 \times \mu \cdot \text{cp.}\right] \text{ lb/ft sec.}}$$

$$= \frac{(1.104)(11.279 \times 10^7)(\rho)(4)}{(\pi)(1.104)^2 (0.000672)(\mu \cdot \text{cp.})}$$

μ in cp at T_r and P_r average

= μ at $T_r = 1.286$ and $P_r = 1.49$

= 0.0127 cp

ρ in lb/ft³

$$\rho = \frac{W}{V} = \frac{PM}{ZRT}$$

$$= \frac{(1.49)(671.3)(20.2)}{(0.74)(10.72)(510)}$$

$$= 4.994 \text{ lb/ft}^3$$

$$R = \frac{(11.279 \times 10^7)(4.994)(4)}{(\pi)(1.104)(0.000672)(0.0127)}$$

$$= 7.62 \times 10^8$$

Since this value for R is higher than can be read on *Fig. 7*, the original estimate for the friction factor is substantially correct, and therefore, the calculation for the flow rate Q, is correct.

• *B. Unknown pipe diameter*

A procedure similar to that described above is used when the unknown factor is the pipe diameter. The difference between solving the two problems lies in the first estimate of the friction factor. When the pipe diameter is unknown, it becomes necessary to estimate both the diameter and Reynold's number and then use the corresponding friction factor in equation (8) as before. The remainder of the above procedure is unchanged.

• *C. Unknown pressure*

The method is very simple for calculations involving an unknown pressure. All the known values are

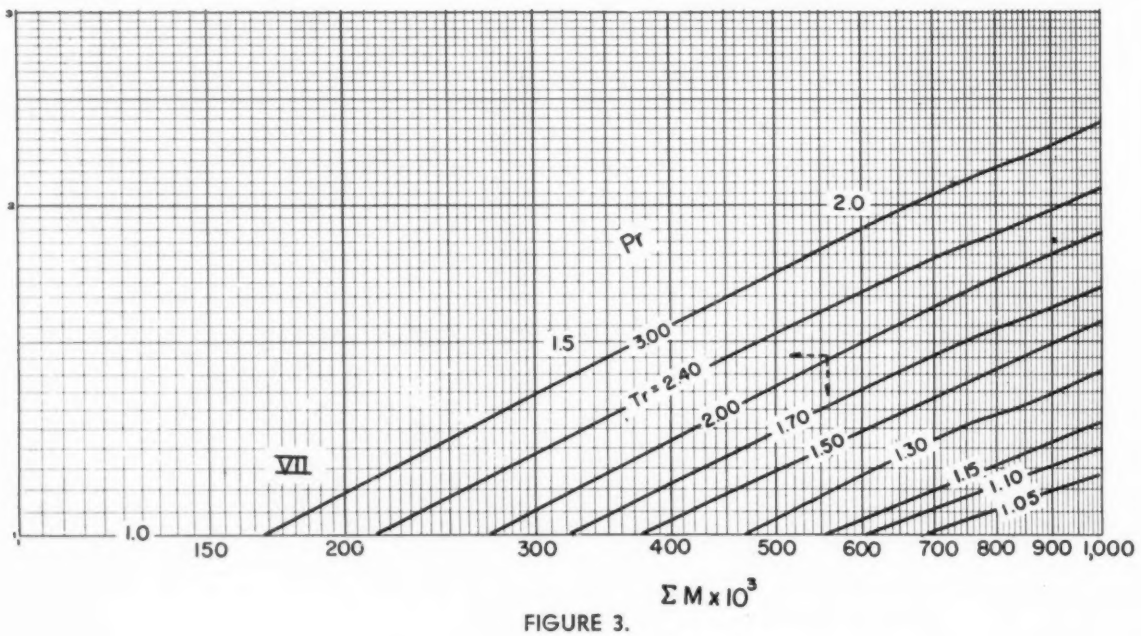


FIGURE 3.

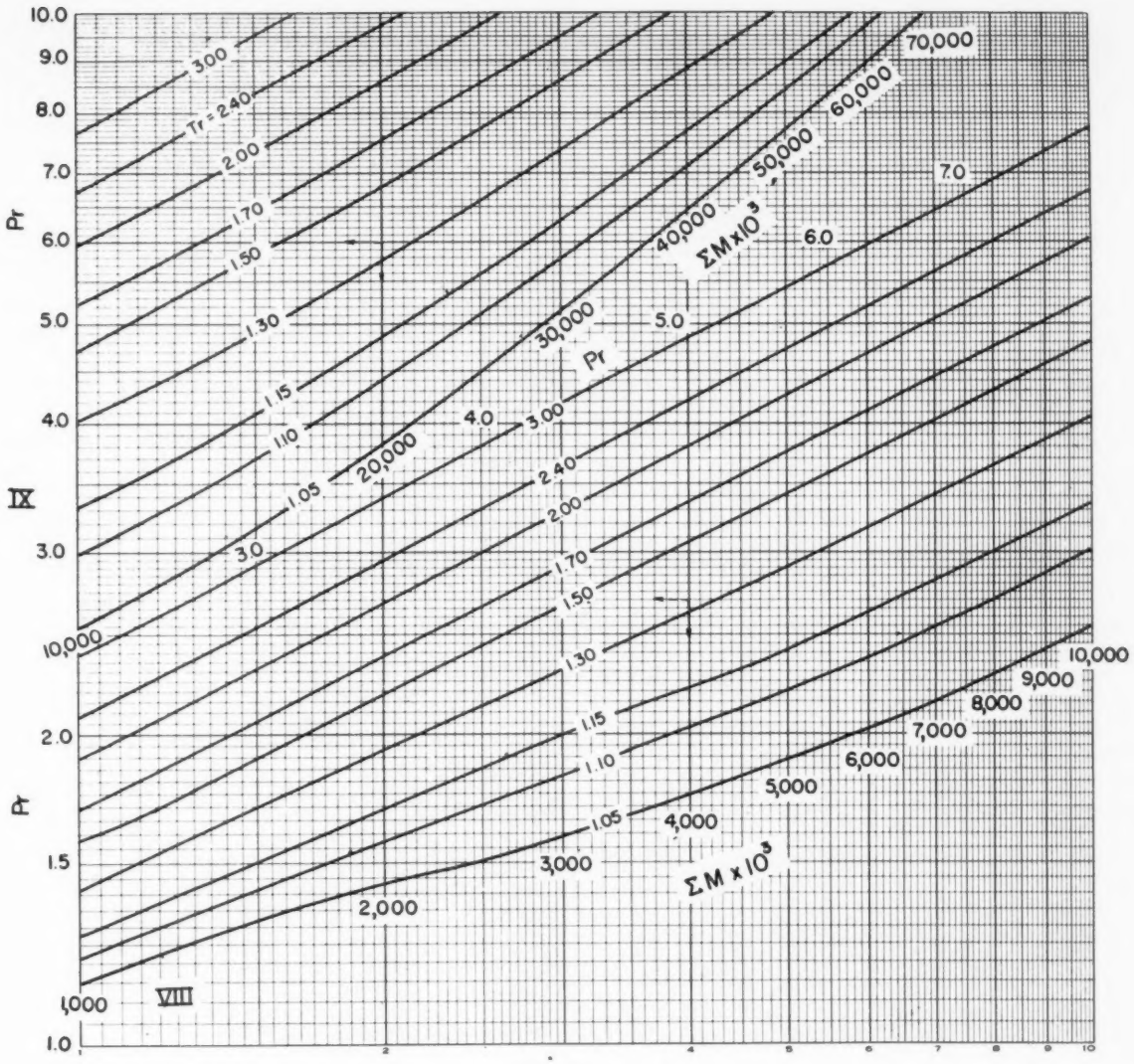


FIGURE 4.

substituted in equation (8) and the value of ΣM is calculated. Now, by knowing ΣM_1 it is a simple matter to solve for the unknown ΣM_2 and vice versa. The pressure corresponding to the unknown ΣM_1 or ΣM_2 is then determined by using *Table I* as follows:

The data used in this problem will be the same as in the previous example, except the flow rate Q is now 97,620 Mscfd and it is required to find the inlet pressure P_1 which will result in an outlet pressure P_2 of 500 psia.

$$\Sigma M = \Sigma M_1 - \Sigma M_2 = \frac{Q^2 P_o^2 fLGT_c}{(1986.5)^2 Z_o^2 T_o^2 P_c^2 D^5}$$

$$\Sigma M = \frac{(9.762 \times 10^4)^2 (14.65)^2 (2.65 \times 10^{-3}) (1.056 \times 10^6) (.697) (396.7)}{(1986.5)^2 (1)^2 (520)^2 (671.3)^2 (1.104)^5}$$

$$= 2.0314$$

$$= \Sigma M_1 - \Sigma M_2 = \Sigma M_1 - 0.253$$

Therefore: $\Sigma M_1 = 2.031 + 0.253 = 2.284$

Straight line interpolation is performed in order to determine P_{r_1} from $\Sigma M_1 = 2.284$ at $T_r = 1.286$

From which:

$$P_{r_1} = 2.0147 \text{ and}$$

$$P_1 = (2.0147)\ (671.3) = 1352 \text{ psia,}$$

which is the inlet pressure required to give the above flow rate with the given outlet pressure.

If it is desired to know what discharge pressure will result for a given inlet pressure, one merely converts the inlet pressure to reduced conditions, finds the corresponding ΣM in the table, subtracts 2.284 and reads the outlet pressure for the corresponding ΣM. This procedure is simplified and accurate. The value of ΣM, i.e., 2.284 means that in the basic calculations the line was considered divided into 2,284 units for purposes of giving proper recognition to

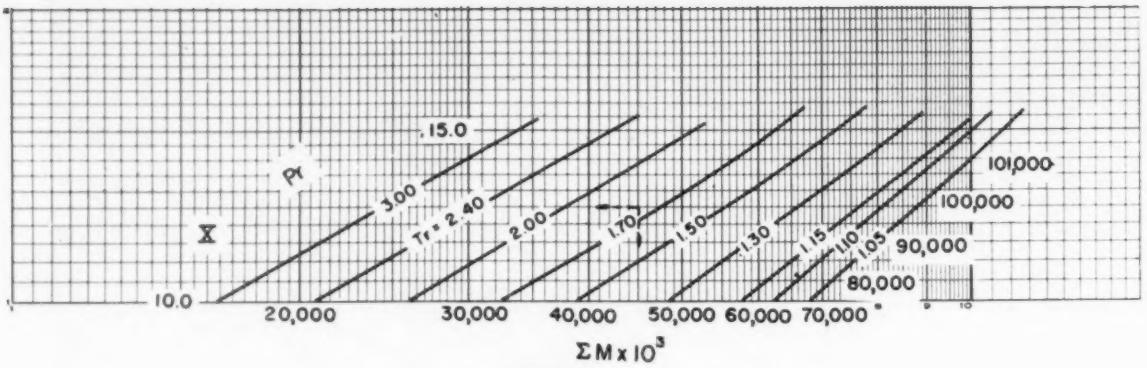


FIGURE 5.

the changes in gas properties.

The type of calculation requiring that the inlet pressure be determined for various outlet pressures or vice-versa is ideally suited for the tables and figures presented here.

• *D. Deliverability curves*

Curves of the type shown in *Fig. 8* are desirable for pipelines already in use. These curves show how changes in inlet and/or outlet pressures affect capacity.

Deliverability curves are calculated in the same manner as in calculating an unknown pressure. For a given pipeline, inlet pressures required to give various outlet pressures are calculated for several flow rates.

For purposes of these curves, equation (8) can be written as:

$$\Sigma M = \Sigma M_1 - \Sigma M_2 = Q^2 f C$$

Where:

$$C = \frac{P_o^2 LGT_c}{(1986.5)^2 Z_c^2 T_o^2 P_c^2 D^5}$$

If all flow rates considered are within the turbulent region, the friction factor, f, can also be included in the constant, C.

Fig. 8 was calculated for a line having the following properties:

D = 5.761 in.
L = 100 miles
T = 60° F
G = 0.700

In reviewing the procedures presented here, it will be found that a change in flow rate, pipe diameter, etc., amounts to an expansion or contraction of the abscissa, shown in *Figs. 1-5*. This is readily seen by referring to equation (4). If the flow rate, gas gravity or friction factor increase, the incremental length of pipe, ΔL must decrease in order to maintain the equality of the equation. If the pipe increment ΔL is shorter, more integrations are required to include the total pipe length L. This results in an expansion along the abscissa of *Figs. 1-5*. If the pipe diameter increases, the pipe incremental length, ΔL must be greater to maintain the equality. This means that fewer integrations are required to obtain the pressure drop over the pipe's entire length or is

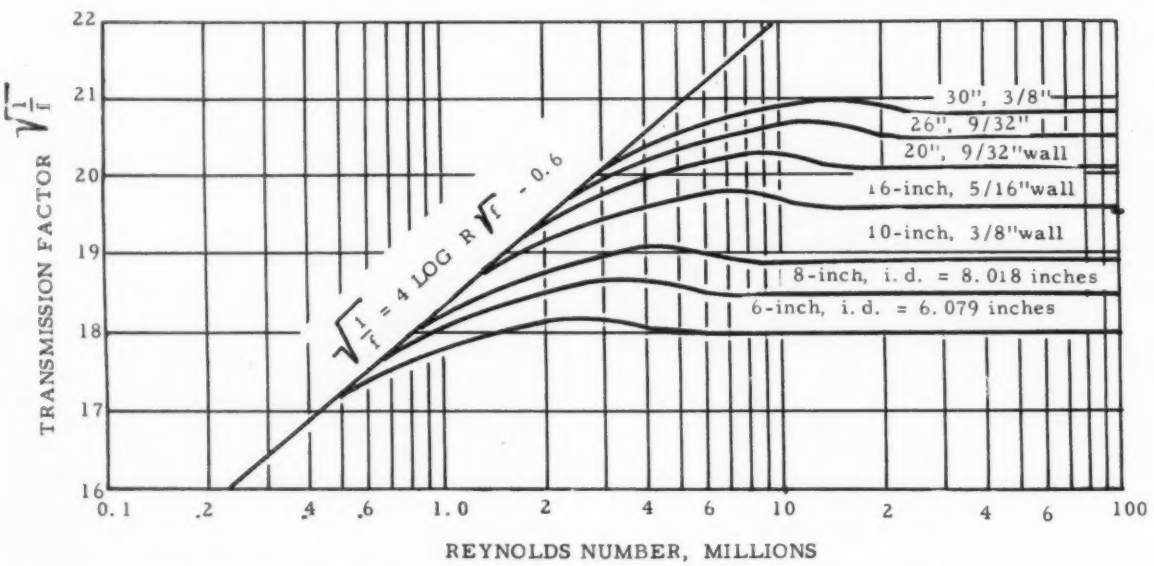


Fig. 6. Transmission factors for pipes of various sizes with an absolute roughness of 0.007 in.

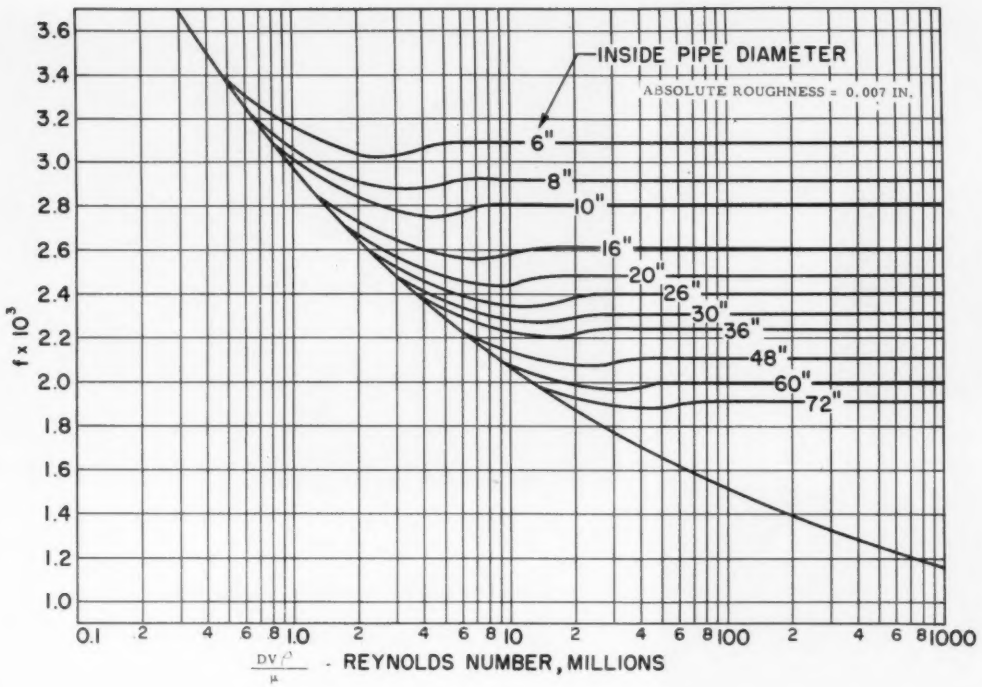


Fig. 7. Friction factor chart.

equivalent to a contraction along the abscissa.

This new technique for calculating the pressure drop in pipelines is based on a method of dividing the line into hundreds or thousands of increments, so that detailed consideration may be given to the changes in gas compressibility. In order to use this method, it is necessary to have friction factors which were obtained on very short pipe lengths where extraordinary care could be given to the gas properties. The friction factors or transmission coefficients obtained by Smith, Miller and Ferguson provided these type of data. The pipe lengths used by Smith, Miller and Ferguson were very short and care was given to the changes in gas compressibility for their particular pipe. The method developed here is well suited for use with their friction factors. The resulting pressure distribution curves presented here are universal curves and may be used for any gas flow in any pipelines where rigorous accounting should be taken of changes in the compressibility of the gas. If at some later date improvements are brought about in the friction factor charts the universal curve may still be used with only changes in the factor as shown in the equation.

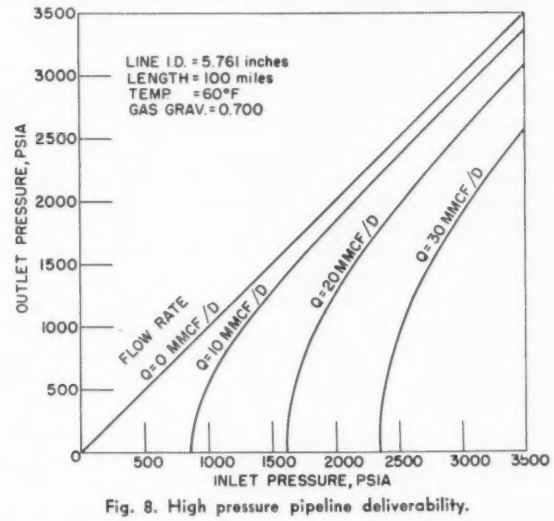


Fig. 8. High pressure pipeline deliverability.

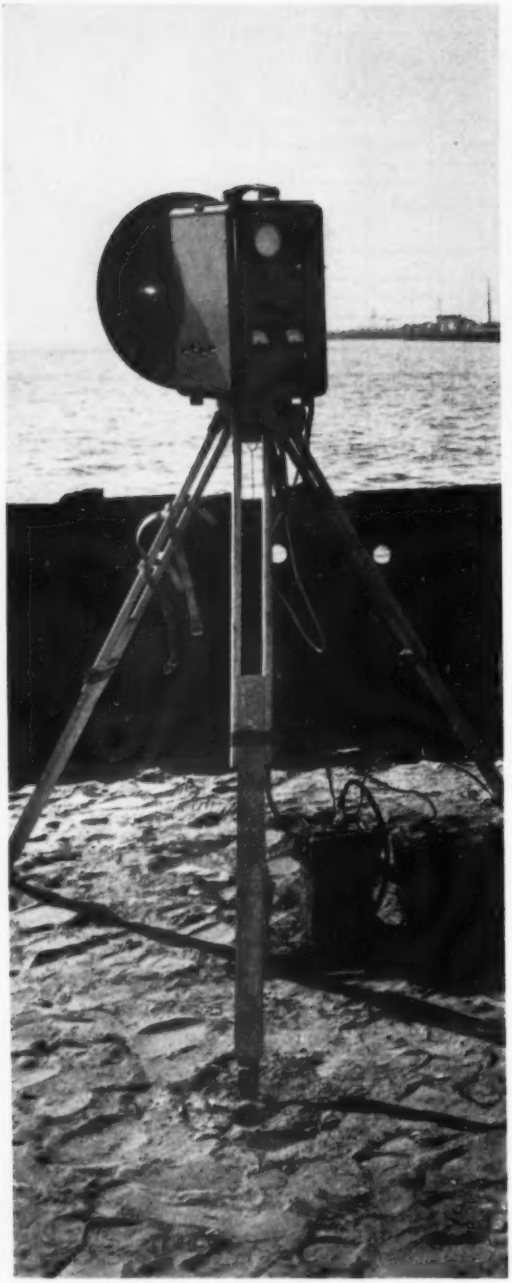
These universal charts may also be used for another purpose, i.e., that of obtaining good friction factor data. It is the present practice in estimating friction factors in gas lines to use an average compressibility from an inlet pressure to a discharge pressure. A tremendous advantage in these charts is that it will permit one to calculate the transmission coefficients or friction factors more accurately by using actual pipeline data. Such transmission coefficients even though obtained on long lines will have included a rigorous consideration for the changes in the gas compressibility, for such is the property of these universal charts. Perhaps one of the significant advantages of these charts will be that it will permit the engineer to develop more accurate friction factor charts from pipeline data. ■

ACKNOWLEDGEMENT

The writers wish to express their appreciation to Dr. George H. Fancher, director, for encouragement of the work. Appreciation is expressed to the research committee for permission to publish the results.

REFERENCES

1. Weymouth, T. R., *Trans.* ASME, 34, 185 (1912).
2. Clinedinst, W. D., *The Oil and Gas Journal*, Page 79, April 7, 1945.
3. Nisle, R. G., and Poettmann, Fred H., "Calculation of the Flow and Storage of Natural Gas in Pipe," *Petroleum Engineer*, Jan., Feb. and March (p. 165), 1955.
4. Smith, R. V., Miller, J. S., and Ferguson, J. W., "Flow of Natural Gas Through Experimental Pipe Lines and Transmission Lines," Bureau of Mines, Monograph 9.



Tripod-mounted Tellurometer is powered with a 6-v storage battery.

Pacific Lighting Gas Supply Co. saves time and money

Surveying

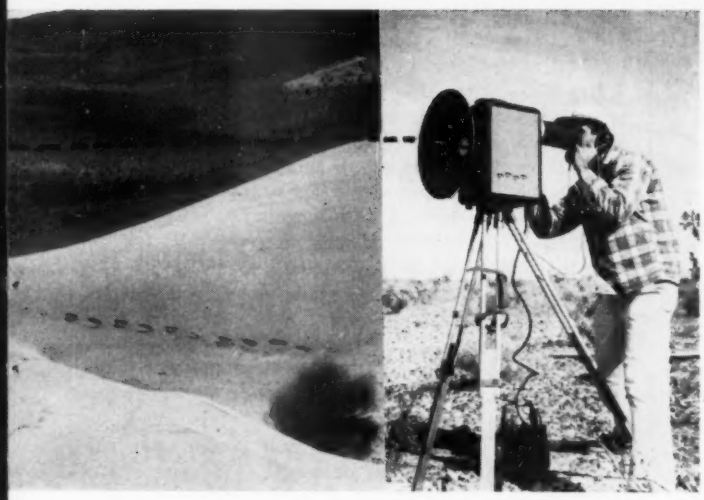
WITH the aid of a recently developed survey instrument—a Tellurometer—a pipeline route survey was completed for Pacific Lighting Gas Supply Co. with a saving in both time and money. The Tellurometer is designed to perform one function, that of measuring long distances with accuracy and speed.

This is the first gas pipeline job on which the instrument has been used.

Part of a project to bring additional out-of-state gas to southern California is the installation of approximately 117 miles of 34-in. pipeline starting at the Colorado river and extending westerly. The river crossing will be located approximately six miles north of Needles, Calif., with the entire route lying in desert wasteland. Except for about 10 miles located in rolling hills, the route lies in flat terrain with no unusual surveying problem.

An interesting feature of the job was the existence of old gunnery and tank training ranges used during World War II. There was no guarantee that three sections of the route, totalling six miles, were free of dud projectiles or practice land mines. The time schedule did not permit clearing the strip prior to the survey so it was necessary to survey these sections without entering them. Fortunately, the route was free of horizontal angle points across these sections.

By MAURICE E. FULLER
Pacific Lighting Gas Supply Co.
Los Angeles



Two major components — both equipped with a radio transmitter and receiver—are used in a desert line survey. Distances are measured by calculating the time it takes a radio wave to travel between two points.

pipeline routes by radar

Landowners were numerous for the barren country of the route. In addition to desert land entries and mining claims by individuals, there was a one mile square checkerboard pattern of alternating ownership by a railroad and the U. S. Department of Interior. The total number of owners was 35, with 94 parcels to be crossed and located by the survey.

Five U. S. Coast & Geodetic Survey monuments located within two miles of the pipeline route were used to establish basic control for the survey. A sixth monument, approximately 12 miles from the route, was utilized to establish the basis of bearings.

Although the pipeline route was through wasteland where a wide right-of-way could be secured at reasonable cost, the survey had to accomplish substantially the same things as one made in more highly developed areas. Bids for the route survey were taken, providing among other things, that each point located by the survey was to be accurate within 5 ft of its true position and that the Lambert coordinates of each horizontal angle point and control point were to be determined. The surveyor was given plats produced from data taken from preliminary title reports, showing owners located within one quarter mile of the route and was required to determine which owners were crossed.

Aerial Control, Inc., Woodland Hills, Calif., was the successful bidder. This firm had worked for the company a year earlier to establish ground control in mountainous country in connection with a pipeline route survey by photogrammetry. Because of the long sight distances on the desert route, the photogrammetric process was not best suited. Therefore, Aerial Control made its proposal based on using a Tellurometer which is capable of measuring distances up to 40 miles with one set-up. Distances are determined from the time it takes an ultra high frequency radio wave to travel from a transmitter to a reflector and back. By measuring the phase relationship of the transmitted and reflected radio wave, the time interval is measured in billionths of a second. Distances shorter than 500 ft are difficult to measure, but high order accuracy is possible on longer distances. Accuracies which can be expected are as follows:

Length of Line	*Accuracy*
500 ft to 1500 ft	1 : 5,000
1500 ft to 1 mile	1 : 10,000
1 mile to 40 miles	1 : 20,000

The Tellurometer consists of two major components, both equipped with a radio transmitter and receiver,

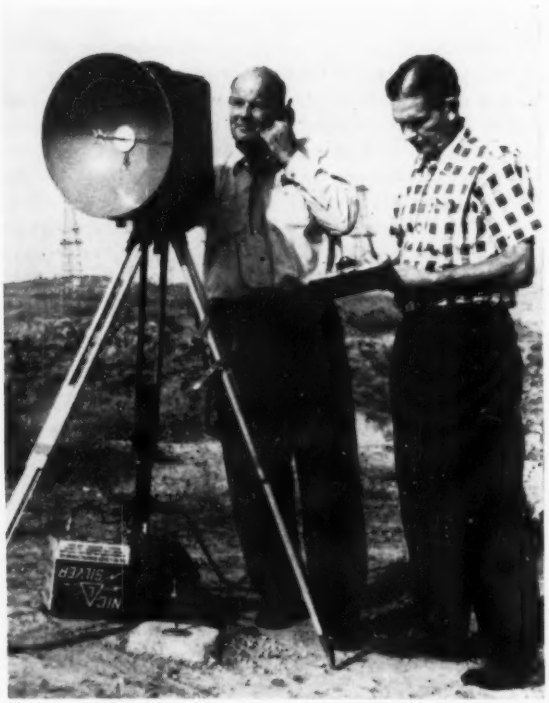
sometimes referred to as the "master" and "remote" units. When in use, each unit is mounted on a tripod and is powered with a 6-v storage battery. The total weight of each unit is about 85 lb, making for portability. Each unit contains a variable frequency crystal, capable of producing radio waves in range of 2900 to 3200 megacycles per second. In order to provide communication, a short wave radio is built into each unit. The master unit is equipped with a 2½-in. diameter oscilloscope, marked with 100 radial lines. When the equipment is in operation, there appears in the oscilloscope a circular pattern having in it a break about ⅛ in. long, measured along the circumference. The leading edge of the break in a clockwise fashion will appear at a position on the scope which represents the time interval for the radio wave to travel from the transmitter to the receiver and back. Each radial line on the oscilloscope represents a time interval of one billionth of a second which, translated into the velocity of a radio wave, represents a minimum distance of approximately 6 in. Readings of the oscilloscope can be interpolated so distance determinations are accurate within about 2 in. This accuracy is independent of the length of line under measurement.

By modulating the radio wave, readings on the scope are successively taken in units of 50 ft, 500 ft, 5000 ft, and 50,000 ft. When set to read in 50-ft units, the pattern on the scope will rotate once through 360 deg. as the Tellurometer units are moved 50 ft along the line being measured. Similarly, when set on 500-ft units, the Tellurometer must be moved 500 ft for the scope pattern to rotate one revolution, etc.

Simply stated, the measurement with the Tellurometer is done by determining how many of each of these units lengths is contained in a given distance. From this characteristic of the equipment it may be seen that one must know to the nearest 50,000 ft the length of the line being measured. It also accounts for the fact that accuracy is maintained over the complete range of the instrument.

Set-up and operation time for measuring a line, regardless of its length, is about 30 minutes. With the master unit and remote unit at opposite ends of the line to be measured, the conditions which affect the velocity of the radio wave are noted before and after the time interval is measured. These factors are air temperature, atmospheric pressure, and relative humidity. Graphs containing the variable for these factors have been prepared from which the standard velocity is readily determined. Included in the operation for each length measurement is a check of the results by measuring the time interval with additional radio waves of different frequency. For this survey, the control traverse distances were measured by taking readings on six frequencies. If a

Each unit weighs about 85 lb, making for portability.



A short wave radio is built into each unit.

TABLE 1
Results of Basic Control and Section Traverses

Traverse	No. of courses	Average length /course (ft)	Traverse closure distance (ft)	Average correction /course (ft)	Ratio of error
Basic	10	60,313	11.65	1.16	51,770
1	25	3,480	7.02	0.28	12,460
2	7	6,540	1.94	0.28	23,610
3	24	6,450	13.29	0.56	11,400
4	23	6,330	7.20	0.31	20,190
5	10	2,428	2.20	0.22	11,030
6	9	5,150	4.43	0.49	10,430
7	24	5,900	13.31	0.55	11,000

variation was noted on any frequency setting, additional readings on a different frequency were taken until consistent results were obtained. For the traverse of the pipeline route, readings were taken on four frequencies. In addition to these readings, the vertical angle between the ends of each line and the horizontal plane was measured. This information was used to reduce to a horizontal distance the slope distance which is measured by the Tellurometer. The elevation was obtained at each point for which Lambert coordinates were to be determined, so the coordinates could be based on a plane through mean sea level. For this survey, elevations could be obtained with sufficient accuracy from U.S.G.S. quad sheets.

The field survey was done in two distinct phases. In the first phase, a basic control traverse was run for the entire route with ties to nearby U.S.C. & G.S. monuments. Following this, a traverse of the pipeline centerline was run in seven sections and adjusted for each section to the values determined on the basic traverse. At the same time the necessary ties were made for legal descriptions and locating parcels of different owners.

A Tellurometer and a one-second theodolite were used for field work for both phases of the survey. The theodolite was used at each horizontal angle point but since the lengths were determined in only one direction it was possible to leapfrog with the Tellurometer master and remote units. Results of the basic control and the section traverses are shown in *Table 1* to indicate the closure error. Without exception, the accuracy was well within the limits required.

When it is necessary to take data on which calculations are based, it is of interest to know what error in the final result would be introduced by errors in field observations. The effect of assumed errors is shown in *Table 2*. In much work the error introduced by a constant average value for these variables is small enough to be ignored. In *Table 2*, the errors shown are based on a line 60,000 ft long.

TABLE 2
Effects of Assumed Error

Observation	Assumed error in observation	Resultant error in measured length (ft)
Air temperature	10° F.	0.18
Atmospheric pressure	0.1" Hg.	0.06
Relative humidity	10%	0.18

An outstanding feature of the survey was the speed with which it was made. In three days, Tellurometer work for the basic control survey was completed on the entire route. This speed was possible because of the long sight distances which permitted single set-up measurements up to 30 miles long. Field work on the pipeline traverse (including measurement of both the angles and distances) required three weeks in the field. A three-man crew was used in taking length measurement on the basic control survey while a total of six men were used on the pipeline traverse.

It is difficult to demonstrate what savings in cost could be traced to use of the Tellurometer. No bids were taken for a conventional survey, but it is believed likely that the company realized a savings of about 15 per cent. Had a conventional survey been made to the same degree of accuracy, it is expected that the savings would have been considerably more.

The Tellurometer has certain characteristics which should be remembered when considering its use.

1. *It is capable* of producing accurate results.
2. *With precise length measurements,* a traverse is a "strong" survey and the results of triangulation can be achieved by traverse with less field and computation time.
3. *Measurement is speedy;* no more time is needed for long lines than for short ones.
4. *The Tellurometer* is of limited usefulness on lines shorter than 500 ft.
5. *There is no need* to occupy the line being measured except at the ends.
6. *Measurement is possible* without seeing between the master and remote units. Fog, haze, darkness do not affect the Tellurometer.
7. *The units* need not be precisely pointed at each other. An angle of 20 deg. does not affect the result.
8. *Steps should be taken* to guard against error introduced by interference by other radio waves.
9. *The distance* measured is slope distance.

Based on this experience with a Tellurometer, Pacific Lighting Gas Supply Co. feels that it is a valuable addition to the growing list of tools now available to the modern surveyor. For surveys where long distances are to be measured, the Tellurometer is at its best. Where the survey is to be through mountainous country, the Tellurometer is believed to be most useful to establish ground control for a survey by photogrammetry.

It is felt that on a survey of any magnitude, the Tellurometer or similar instrument will achieve a better combination of accuracy and speed than possible if length measurements are left to the conventional surveyor's chain. ■

This article is adapted from a talk presented at the PCGA transmission conference held in Palm Springs, Calif., in April.

Here is a discussion of the operating characteristics of the Type AB calorimeter, a piece of equipment which is widely used throughout the gas industry. A later model calorimeter is also now on the market. However, this article deals only with the "all brass" unit.

Installing and testing recording calorimeters

By **S. M. KEEHN,** General Meter Inspector

Cities Service Gas Co., Wichita, Kan.

WITH the demand and price of natural gas ever on the increase, the importance of correct Btu measurement has definitely increased. In some localities the heating quality of the gas has more bearing on the value of the gas than in others, but it is very apparent that the whole gas industry is becoming more Btu conscious.

Gas measurement involves not only the quantity of gas but also the quality of the gas. The factors to adjust for variables such as temperature, specific gravity and supercompressibility are usually applied in the flow equation for volume. Adjustment for heating value is usually applied in the form of a price adjustment based on a specified heating value. The actual heating value is determined by means of the recording calorimeter. Since the heating value has this direct bearing on the price paid for the gas, the importance of an accurate determination of this property of natural gas is realized. Since the prime interest here has to do with heating value measurement only, this article will deal with things one can do in installing and operating the calorimeter to insure maximum precision in obtaining correct results.

The Cutler Hammer AB recording calorimeter is capable of an accuracy better than one-half of 1 per cent under controlled conditions, but in reaching for this high precision one must control the extent that conditions surrounding the calorimeter can be allowed to vary. To fully appreciate what these limitations are, we must understand what the calorimeter consists of and how it operates.

The Type AB recording calorimeter (The term AB is an abbreviation for "all brass" to distinguish this

GAS exclusive

Fig. 1 (above). Composite view of complete AB calorimeter. The instrument consists of two parts, the tank unit and the recorder.

instrument from its predecessor, the Thomas calorimeter) consists of two parts, the tank unit and the recorder (*Fig. 1*). The tank unit is partially filled with water and contains three meters (gas, combustion air, and heat absorbing air). The meters are mounted in the water tank adjacent to a storage compartment of smaller capacity containing a reserve supply of water. A cam-operated water pump takes water from the water storage compartment and delivers it into the main tank, where the excess flows over a weir and returns to the reserve compartment. Thus the water level in the main tank is automatically kept constant.

The gas meter, combustion air meter, and heat absorbing air meter measure and deliver a definite quantity of gas, combustion air and heat absorbing air respectively. Gas is burned at a constant rate, and the heat developed is absorbed by a stream of air. The rate of flow of the gas, air for combustion, and the air for the absorption of heat are regulated by the three meters. These meters are geared together and driven by an electric motor, so that the ratios of the rates of flow of gas, combustion air, and heat absorbing air are constant. For testing, interchangeable gears of other ratio are supplied. The gas meter is adjustable, so as to be able to make allowances for bearing wear and the accumulation of deposits inside the meters.

Gas to be tested flows from the supply line through a pressure reducing regulator and a pressure reducing orifice to the inlet chamber of the gas meter (*Fig. 2*). About 80 per cent of it escapes through a bleeder burner and about 20 per cent is used by the gas meter. This part of the design of the calorimeter is such that the resistance to flow of gas from the inlet chamber of the gas meter to the excess burner of bleeder burner is small. The pressure in the chamber will be nearly the same as atmosphere. Since the gas and the air are at the same temperature and saturation, and since measurement is at atmospheric pressure, the need for corrections to volume is automatically eliminated. After leaving the gas meter, the gas is mixed with air from the combustion air meter, and this mixture then flows to the calorimeter burner. The products of combustion are kept separate from the heat-absorbing air and are cooled very nearly to the temperature of the air. The water formed in combustion is condensed to the liquid state. The air from the combustion air meter is divided into three streams of air by orifices. Two streams are primary air and enter the gas stream at two points between the gas meter and the burner. The third flows up around the burner tube and is a supply of secondary air for combustion.

The burner assembly is located in a chamber that is closed at the top and open at the bottom, so that the products of combustion rising from the burner are deflected and caused to flow downward. There are three tubes in the assembly (gas, combustion, and fluted tube). The fluted tube has a system of fins attached to the outside of the burner chamber. Its purpose is to promote heat transfer, since the heat-absorbing air flows upward around the burner chamber. To reduce heat loss the whole burner assembly is surrounded by a double-walled, nickel-plated burner jacket. The heat-absorbing air flows between the walls after passing the outlet thermometer. The inlet thermometer is in the same stream of air before it reaches the burner assembly.

The second part of the calorimeter is the measuring system or recorder (*Fig. 3*). The recorder measuring system employs the Wheatstone bridge principle. The electrical measuring circuit has a slide wire and rheostat as variable resistance in the circuit. Two electrical resistance thermometers (inlet and outlet heat-absorbing air) are located in the calorimeter tank unit and serve as the first and second leg of the circuit. The two fixed cells in the recorder serve as the other two bridge legs. The galvanometer is connected across the circuit. When the resistance of the outlet thermometer changes (due to the rise or fall in temperature of the heat-absorbing air) the galvanometer

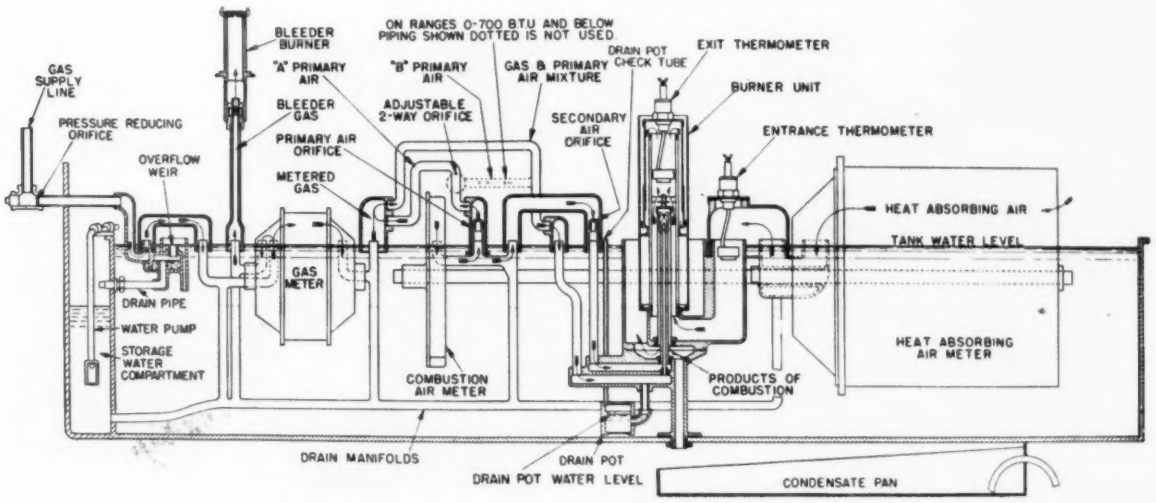


Fig. 2. Flow diagram for Cutler-Hammer's Type AB calorimeter.

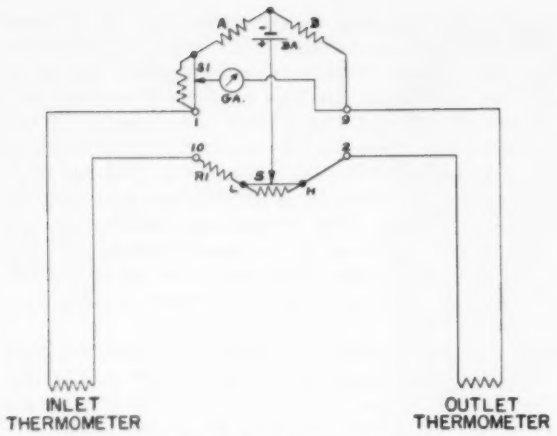


Fig. 3. Measuring system or recorder.

pointer is deflected and a mechanical restoring mechanism moves the slide wire rheostat until the circuit is in balance again. Thus, the position of the sliding contact is a direct indication of the temperature difference between the two thermometers, and this in turn is recorded by a pen which moves across the chart by means of a slide bar. A violin string serves as a belt to which the pen is attached. This belt runs over a series of pulleys and around the violin string disc to which the slide wire rheostat is attached. Any change in heating value will cause movement of the slide wire rheostat and will cause the pen to move and indicate a change in reading on the rolled chart which is graduated in Btu per cubic foot, and which also accounts for time. Most calorimeters record the Btu per cubic foot at 30-in. Hg—60 deg. F saturated with water vapor.

When preparing for the installation of a new calorimeter it is important to specify just what the instrument should consist of to fully meet all requirements. First, it is recommended that the calorimeter gives Btu results referred to the same base as specified in the contract. Next in importance is the selection of the proper range. The lowest practical range should be selected, since calorimeter accuracy is always in terms of the instrument range. To illustrate, one-half per cent accuracy on a 1500 Btu range is 7.5 Btu, whereas on a 1200 Btu range it is 6 Btu.

The location for a calorimeter installation should be carefully selected so as to insure trouble-free operation. The site should be as near as possible to the gas or gases to be sampled, power facilities and water facilities. The calorimeter should be installed in a draft-free room but with good ventilation. Do not allow the direct rays of the sun to strike the tank unit as any rapid change in temperature may result in erroneous readings. An ideal building to allow ample working space is one about 8 ft x 12 ft. It should be well insulated and equipped with a thermostatically controlled heating and cooling system.

The tank unit and recorder unit may be installed in the same room or in separate rooms but should be separated by no more than 100 ft. The room temperature range should be between 60 deg. and 90 deg. F and free from sudden changes in temperature. A temperature range of from 70 deg. to 75 deg. is ideal.

Neither the tank unit or the recorder unit is suitable for use in areas where explosive conditions exist. A serious objection other than the obvious hazard is that combustible gases may contaminate the atmosphere, and even a slight trace will adversely affect the accuracy of the calorimeter. This is due to the combustible matter being added to the flame as part of the combustion air, resulting in a high reading.

• Power Supply

The power supply should be steady with regards to frequency and voltage. If possible use power furnished by the local power companies. All wiring should be in rigid conduit, but flexible connections should be made at both the recorder and tank unit so as to eliminate any vibration that might travel through the conduit. All wiring should be #12 solid copper wire. It is suggested that all electrical conduits be channeled in the floor if at all possible. This will improve the appearance and working conditions around the installation.

• Water Supply

Tap water is generally satisfactory for use in the tank unit. The manufacturer states that water suitable for drinking is usually satisfactory. Where the water is known to be corrosive it should not be used. For best results use distilled water if it is available.

• Sample Lines

Sample lines should be as small in diameter and as short in length as possible so as to eliminate time lag. As a safety measure, one or more stage regulation is recommended for high pressure sampling at or near the point of sampling. The pressure of the gas sample entering the calorimeter room should be held relatively low and should not exceed 30 in. of water pressure at the inlet side of the small regulator furnished

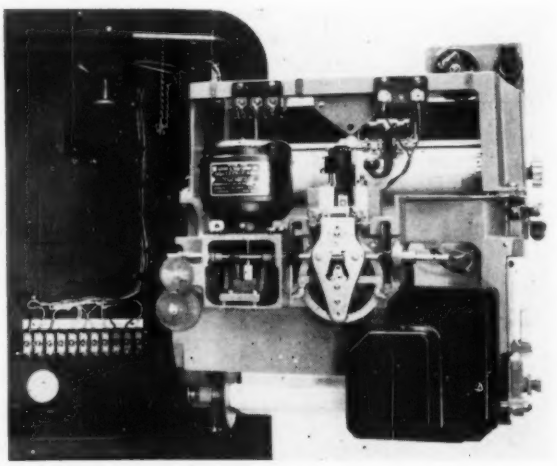


Fig. 4. Recorder with unit swung out.

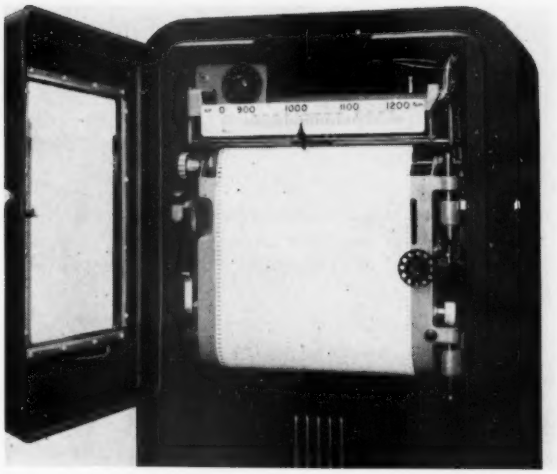


Fig. 5. Calorimeter recorder with door open, 0-900-1200 range.

with the calorimeter. The pressure of the gas going into the calorimeter should be 4 or 5 in. of water.

• Testing

The recording calorimeter is a precision instrument and cannot be expected to give satisfactory results without regular care and attention. The record obtained from the instrument will be no better than the care and maintenance the instrument receives.

Frequency of tests and inspections may vary with location and conditions. The following is a suggested weekly check list.

Tank unit

1. Oil motor bearings and bushings.
2. Check grease level in speed reducer.
3. Check seal pot.
4. Check water in main and auxiliary tank.
5. By using syringe, flush overflow weir and entrance to gas meter.
6. Remove and inspect burner tubes and clean with soft brush. Grease threads and clean burner jacket.
7. Check orifices and clean.
8. Check condition of inlet and outlet thermometers and clean with soft brush.
9. Check condition of all moving parts.

Recorder

1. Check galvanometer, clean pointer, clamping bar, and check for balance.
2. Clean lift bar, clutch disc, and setting levers. Oil all pin bearings, moving parts, and wipe off excess oil.
3. Check all bearings.
4. Clean slide wire and contacts (use the utmost care in cleaning slide wire).
5. Check pen and chart alignment with scale.
6. Clean pen and refill with ink if necessary.
7. Check mechanical balance.
8. Check cold balance and rheostat setting.
9. Check rectifier for sensitivity.

It is advisable to check the sensitivity of the recorder in relation to the output of the rectifier. This check is made during a cold balance test. At this time the galvanometer pointer is in the neutral position with relation to the stationary clamping bar in the balancing mechanism. The first step would be to stop the recorder and mark the position of the pointer on the stationary bar, then make a mark ⅛ in. from the neutral position. The second step would be to rotate the cam manually until the clutch arm is free of the clutch disc, then slowly move the clutch disc with the balance switch in the "on" position until the galvanometer pointer is in line with the mark on the stationary bar. For this ⅛-in. deflection of the galvanometer the pen of the recorder should have moved 3.2% ±0.4% of full scale using 2.5 mill suspensions strip with the 900 to 1200 split scale instrument or 6.6% ±.8% using 3.0 mill suspension strip used with the 0 to 1500 standard scale instruments. If the recorder does not conform to the above tolerances, the output of the rectifier should be adjusted so as to be within these tolerances. This will eliminate the overheating of the thermometers.

The mechanical balance is a test of the recorder mechanism (*Fig. 4*). The first test is made with the galvanometer removed. During this test the pen should draw a straight line while the instrument is running. If a creeping condition exists and is in a clockwise direction (pen moving up scale looking at clutch disc face), the locking screws should be loosened and the adjusting screw on the left should be turned in a clockwise direction and the one on the right turned in a counter-clockwise direction. If a counter-clockwise creep results, the adjusting screws should be turned in the opposite direction of a clockwise creep. Locking screws should be tightened after correcting the creeping condition.

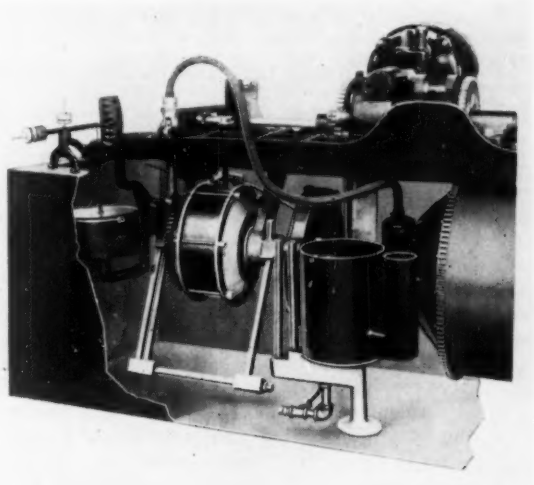


Fig. 6. Recording calorimeter showing location of prover for air-to-gas ratio test.

The next step in testing the recorder is the installation of the galvanometer in the instrument and the adjustment for mechanical balance. During this test the pen should also draw a straight line. To adjust the mechanical balance of the galvanometer, it is necessary to run the instrument with the toggle switch adjacent to the balancing rheostat in its "off" position. The instrument should then maintain a constant reading. If the pen carriage creeps clockwise (up scale) the galvanometer adjusting screw should be turned in a clock-wise direction. If it moves counter-clockwise, the adjusting screw should be turned counter-clockwise. When the instrument draws a straight line for at least 15 minutes, the toggle switch should be turned to the "on" position.

The next step is the cold balance test. Ample time should be allowed for temperature stabilization and for recorder mechanism to bring pointer to its zero position on the scale before any adjustments are made on the balancing rheostat (*Fig. 5*). The balancing rheostat is provided to balance the two legs of the bridge system when the pointer is in zero position. If a correction is needed, it is necessary to rotate the rheostat adjusting knob to bring the pointer to zero on the scale (pointer will move in the same direction as the knob).

After making any adjustment on the above tests, one must always be sure to close the recorder door. Any slight draft could cause a deflection of the galvanometer pointer, which would make it rather difficult to balance the instrument.

• Air-Gas Ratio Test

The object of the air-gas ratio test (*Fig. 6*) is to maintain the fixed predetermined volume relation between the metered gas sample and the heat absorbing air. This volume ratio upon which the accuracy of the calorimeter depends should be tested at least every four months in the following manner:

1. The proper gear change must be made.
2. Water entrance to gas meter must be open.
3. Overflow weir must be clean and in good condition.
4. Water level in main tank must be at the proper level.
5. Prover must be in proper balance.
6. Check the system for leaks. *This is important.* To test the system for leaks add a 3-oz. weight to horizontal arm of prover, check movement of prover pointer every 1/9 revolution of air meter. If the system is free of leaks, the pointer should remain stationary. Fractional air meter turns are substantially useless in running air gas ratio tests and should not be used. The test should be continued for at least three revolutions of the air meter. Preliminary adjustments should be made after one revolution of air meter but final adjustment should be made only after three complete revolutions of air meter. Ratio should be within 0.1 per cent per revolution after final adjustment.
7. Remember the air-gas ratio is the principle of operation. *TAKE YOUR TIME.* The accuracy of the instrument depends on your patience. Though all tests are important, the air-gas ratio test is the most important.

• Hydrone Test

The hydrogen test is a check of the overall accuracy of the instrument and should be conducted only after the above mentioned tests have been made.

On preparing for Hydrone test a few points to check are:

1. Proper gear change.
2. Substitute the "hydrogen test cap" for primary air orifice.
3. Insert small hydrogen test orifice screw in the base of the burner tube.
4. Temperature of tank within specified limits (usually 60 deg. to 90 deg.).
5. Water level in tank and drain pot at correct level.

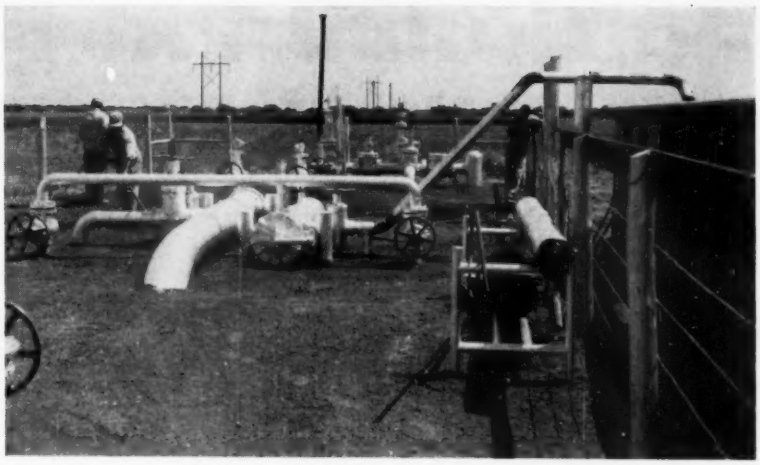
Six steps in handling Hydrone:

1. Hydrone should be handled with tongs for it can cause serious burns.
2. Do not overload or pack cylinder too lightly.
3. Add water slowly to start generation.
4. Wait at least three minutes to light excess gas burner.
5. Wait at least three to five minutes to light gas burner.
6. After burner is lighted, reassemble combustion chamber, fluted tube burner jacket and the thermometer.
   (Theoretical hydrogen test value 87.17 per cent of full scale reading).

Using test gear *A* (27 tooth) driving test gear *B* (33 tooth) and on calorimeter range 1200 Btu, the test is reproducible to 1046 Btu-0.3 per cent of full scale reading. The hydrone test should be run for at least 50 minutes.

The calorimeter is a precision instrument, and if given proper care on a definite schedule of maintenance and testing, very reliable results should be obtained. However, varying conditions affecting the operation may prevent the behavior of the calorimeter from being 100 per cent predictable. It is possible for the calorimeter to operate, having received the weekly care recommended in this article, well within its limits of accuracy, or with weekly deviations in accuracy averaging less than 0.1 of 1 per cent.

A complete record of all service should be kept by calorimeter servicemen. The record should include such information as test dates, hydrogen test values, air-gas ratio results, serial number, chart range, and any part replacements. The serviceman should always remember that his company invested a considerable amount of money in each calorimeter installation and expects a reliable record from each. His best slogan might read: "Take your time, you cannot rush your tests and expect to obtain accurate results." ■



GAS exclusive

Receiving station on 14-in. gas transmission line. The mud tank is at the right, the receiving trap to the left.

The 14-in. sphere is shown here after its trip through the line. Note two piles of sand removed from the trap.

Rubber sphere removes loose debris from line

By R. O. KING, General Superintendent
Industrial Gas Supply Corp., Houston

INDUSTRIAL Gas Supply Corp., a Stone & Webster subsidiary, operates in the coastal region of Texas, where it produces, purchases, transports and sells natural gas for intrastate use. The sales are made to large industrial users, principally in the Houston area. Industrial Gas also produces some distillate and oil.

The company's system consists of about 400 miles of transmission and gathering lines, spanning an area from Refugio county northeast to Houston and southwest from Liberty county to Houston. Gas is gathered from 40 different fields and is delivered to Houston for distribution to 47 industrial wholesale users.

When Industrial Gas purchased these properties in 1950, facilities were constructed to permit pigging while the lines were in service.

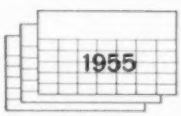
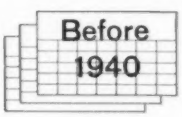
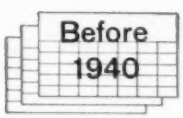
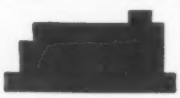
Through a program of pigging the lines at regular intervals, the efficiency of the system was increased from 72 to 92 per cent. It has been possible to maintain this efficiency by using this method periodically.

Conventional pigs, of the rubber cup and wire variety, were used in all these operations, and it is felt that the conventional pigs have removed all scale and debris normally possible to remove by this method. During the past year rubber spheres have been introduced to the industry, and are preferable in removing any liquid accumulation, as they are compressible and capable of maintaining a good seal due to their ability to conform to the inner wall of the pipe. The spheres also have been used to good advantage in removing loose debris from the pipelines. One of the major advantages in using the sphere in pigging a line in service is that if the sphere encounters an obstruction in the line which it cannot move, the sphere will compress sufficiently to pass over the obstruction, rather than hang up in the pipeline. Industrial Gas has used rubber spheres very successfully for filling pipelines with water prior to hydrostatic testing, and purging water from pipelines after testing, and found that the spheres did a thorough job of removing water from a pipeline.

Recently, while pigging a 22-mile section of 14-in. pipeline located at the upstream end of the system, we found that sand had accumulated at a point in the line, due to a carry-over caused by breakdown of

THE UNVARNISHED FACTS

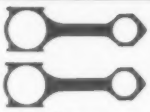
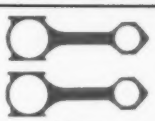
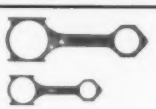
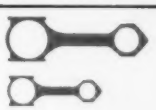
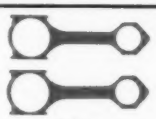
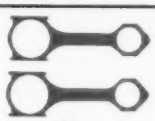
about engine compressors in the 375 to 950 hp range

FEATURE	WORTHINGTON SLHC	MFR. A	MFR. B	MFR. C
DESIGNED FOR TURBOCHARGING	Yes	No	No	No
SELF-SUSTAINED TURBOCHARGING	YES	NO	NO	NO
FUEL CONSUMPTION	7,000 BTU/BHP HR	9,000 BTU's	8,600 BTU's	8,500 BTU's
CYCLE	4	2	2	4
CYLINDER ARRANGEMENT	Inline	Inline	Vee	Vee
RPM	450	600	450	400
YEAR ENGINE WAS DESIGNED	 1955	Before 1950	 Before 1940	 Before 1940
NUMBER OF DESIGNS TO COVER RANGE	1	2	2	2
LARGEST UNIT FOR SKID MOUNTING	950 HP	660 HP	 1100 HP	660 HP

On these two pages you'll find a comparison of all the significant facts about gas engine compressors in the 375 to 950 horsepower range. We think you'll have to agree that Worthington's SLHC unit is the outstanding performer in its size range. Not only does it have 18% better fuel economy than the next nearest engine, but it also features self-sustained turbocharging, removable cylinder liners with cast-in water jacket, interchangeable power and compressor rods, and many other important engineering advances.

For complete details on the new SLHC engine compressor get in touch with your nearest Worthington district office. Or write to Worthington Corporation, Section 43-4, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantfold, Ont.

WORTHINGTON

FEATURE	WORTHINGTON SLHC	MFR. A	MFR. B	MFR. C
MOUNT CYLINDERS ON BOTH SIDES	Yes	No	No	No
CYLINDER LINERS	Removable	Removable	NONE	NONE
INTERCHANGEABLE POWER AND COMPRESSOR RODS	 Yes	 Yes	 No	 No
SIDE BY SIDE CONNECTING RODS	 Yes	 Yes	No	No
FRAME CONSTRUCTION	En-bloc	En-bloc	Separate Cylinders	Separate Cylinders
IGNITION	Twin	Single	Single	Single
RUNNING GEAR LUBRICATION	MANIFOLD CAST IN BASE	SEPARATE PIPE MANIFOLD	SEPARATE PIPE MANIFOLD	SEPARATE PIPE MANIFOLD
GASKET-FREE CYLINDER HEAD SEATS	YES	NO	NO	NO
RUNNING GEAR EASILY ACCESSIBLE	YES	NO	NO	NO

Sand, distillate and water gush into the mud tank.

Mud tank is approximately two thirds full at the close of the operation.

Sand is raked out of the receiving barrel before removing the sphere.

Mud-covered sphere is removed from barrel.

separation facilities on a gas well feeding into the system. This accumulation was discovered when a conventional pig, consisting of three rubber cups and two wire brushes, was run in the pipeline. Movement of the pig was prevented by the accumulation of sand, and a considerable pressure differential was required before the pig could be moved along the line. When the pig was removed at the end of the section, approximately 1½ bbl of sand was found in the pig trap.

The source of the trouble was soon corrected, but it was apparent that the efficiency of the pipeline would be affected and it was necessary that the line be cleaned of all obstructions. A second conventional pig was run through this section of pipeline, and approximately 400 psig pressure differential was required to move the pig and about the same amount of sand was recovered in the pig barrel.

It is assumed when the sand was first encountered, it was possibly crusted and hardened in the line, and the two conventional pigs loosened the sand and scattered it along the line.

It was then decided to try the rubber pipeline sphere. The sphere was inflated with water to ½-in. larger diameter than the inside of the pipeline, as was recommended by F. H. Maloney Co., manufacturer of the sphere.

It was the opinion that there was probably a large volume of sand and water present in the pipeline, and a 4-in. discharge line and a 190-bbl mud tank were temporarily installed at the downstream pig trap to catch anything removed from the pipeline.

The rubber sphere was placed in the pig trap and 30 psig pressure differential was required to start the sphere. After movement started, no more than 10 psig pressure differential was required to maintain movement of the sphere. Approximately 20 bbl of sand and a large amount of water was removed by the sphere on the initial run.

The sphere was then examined and measured to determine the amount of wear. No measurable amount of wear was detected.

The sphere was then run through the section of line for the second time, recovering approximately 5 gal. of water, and only a trace of sand. Again, no more than 10 psig pressure differential was required for the operation.

It has been known from previous experience of Industrial Gas that the sphere was well adapted for removing water and loose objects from a pipeline, and this project proved that the sphere did a thorough job of removing sand and water from a pipeline. It is felt that in this instance the sand was probably held in suspension by the water, due to the velocity and turbulent flow.

The sphere compares very favorably in price with the conventional pipeline pigs, and is light in weight and easy to handle. Another feature which is highly desirable from the standpoint of safety, is the fact that since the sphere is made of rubber, there is no likelihood of a metal-to-metal contact at the pig barrel, which could cause a spark, and possibly result in a fire. ■

GAS • PIPELINE NEWS

FPC overrules examiner in Trunkline case

Overriding an examiner's ruling, the FPC has okayed Trunkline Gas Co.'s $81.4 million expansion plan (Docket G-15394 et al, Op. No. 321).

Two new Michigan customers will benefit from the enlarged capacity. Trunkline's system will be expanded from 375 MMcf daily to 510 MMcf and will provide 129 MMcf daily to Consumers Power Co. and 6 MMcf daily to Michigan Gas Utilities Co., Coldwater, Mich.

Construction includes 895 miles of line and additional compression and looping along its system in Texas and between Longville, La., and Tuscola, Ill. Also, a 204-mile extension from Tuscola to the Michigan-Indiana border where it will connect with facilities of Consumers and Michigan Gas.

CIG needs more capacity for new services

Until additional transmission capacity can be installed, Colorado Interstate Gas Co. cannot comply with requests of its distributors for new service connections without endangering present consumers.

Interstate made this statement to the FPC in connection with a request by Plateau Natural Gas Co. to provide natural gas service to a development of 300 to 500 homes northeast of Colorado Springs. Following Interstate's negative response, Plateau asked the FPC to order Interstate to provide additional gas.

Awaiting a hearing date is Colorado Interstate's $91 million construction program which would provide the Rocky Mountain area with a transmission delivery capacity of 200 MMcf daily.

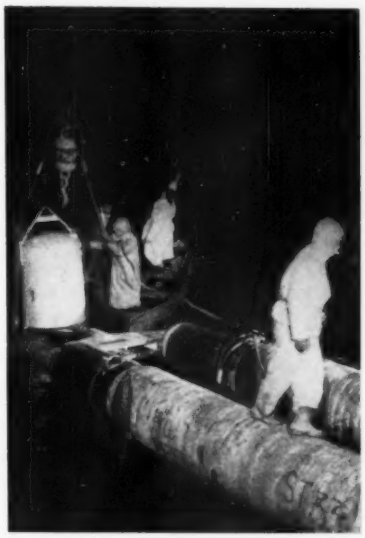
In an effort to meet anticipated demands for the 1959-60 winter heating season, CIG recently applied for and received temporary authority from the FPC to connect gas reserves in the Table Rock field of Wyoming. These reserves will increase delivery capacity by 20 MMcf daily. But, this amount will fall short of meeting estimated requirements for the 1959-1960 heating season.

CIG's direct rates frozen

Colorado PUC put a freeze on rates charged direct customers by Colorado Interstate Gas Co. pending a hearing.

Direct sales amount to about 25 to 30 per cent of Interstate's total business in Colorado.

Touching off PUC investigation of CIG's present rates were complaints registered by Public Service Co. of Colorado and Colorado Fuel & Iron Corp.

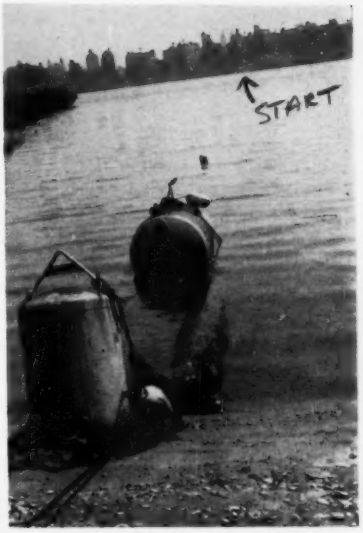


Workmen in boat prepare to bolt down flotation tank on Transco's Hudson lines. Welded-in "nose cones" or caps on first sections form pulling heads for dual lines.

Hudson river crossed in record time

Transcontinental Gas Pipe Line Corp.'s Hudson river crossing, linking the system to the New York metropolitan area, for the third time was completed in record time. The contractors pulled the 4200-ft line across the Hudson in less than a week.

Pipe-pulling crews worked day and night on both sides of the river. One-hundred sixty-foot, 36-ton segments of concrete coated pipe were rolled into specially designed launching ramps. Each segment was then welded to the preceding one, coated with concrete, X-rayed for perfection of weld, and slid into the water.



Pulled through a trench 75 ft under the Hudson from Manhattan (background), twin 24-in. lines emerge from river mud at North Bergen, N. J. Massive pontoons buoyed the pipes during 4200-ft underwater trip.

Two pipe supports located in the water, one 60 ft and the other 120 ft out, guided the pipes to the river bottom. There, the pipe was laid in a previously dredged trench across the river, 20 ft wide and 25 ft deep, placing the pipe 75 ft below mean low water level.

Reclaims wet natural gas

Bureau of Mines researchers have turned up a new inexpensive method for restoring productivity in natural gas wells by removing water accumulations with foaming detergents.

The method, result of basic research conducted by the bureau in cooperation with the AGA, will mean increased conservation of natural gas as well as money saved by industry, particularly small independent producers.

Atlantic gets FPC nod

Atlantic Seaboard Corp., Charleston, W. Va., won approval of its plan to build and operate 26 miles of line and an 8000-hp compressor station (Docket G-18163).

Site of construction is along the company's system in West Virginia, Virginia, and Maryland.

The temporary certificate for the $6.8 million building program specifically excluded the company's proposed 1-mile, 10-in. line to connect with Transcontinental Gas' system near Dranesville, Va.

Seven of the fleet of 12 display and service trailers produced for the F. H. Maloney Co. are shown here. They are now on the job in California, Illinois, Pennsylvania, Oklahoma, and Texas. Each trailer carries at least one of each item made by Maloney.

Underground storage capacity keeps growing

An estimated $650 million has been invested in gas storage facilities by the gas industry. Underground reservoir capacity has been boosted to 2.7 trillion cu ft, the AGA reports.

L. R. Kirk, chairman of the AGA's subcommittee on underground storage statistics, said the industry had nearly 1.8 trillion cu ft of gas in storage at the end of 1958. Kirk, chief geologist of Ohio Fuel Gas Co., made his report at the recent transmission conference.

The association's eighth annual report on underground storage revealed that Pennsylvania, Ohio, Michigan, and West Virginia account for more than two thirds of the total gas in storage reservoirs at year end. A total of 205 storage pools and 8237 active wells are operating in 19 states. This is up from 199 pools and 7969 wells a year ago.

Compressor facilities have expanded correspondingly. In 1957, 130 stations had a total of 411,000 hp. In 1958 this increased to 136 stations with 438,000 hp. "Exceptional growth" was shown by Iowa and Texas last year. Iowa's storage more than doubled, from 13 to 31 billion cu ft, while Texas increased from 26 to 38 billion.

NI-Gas building line

Illinois Commerce Commission okayed Northern Illinois Gas Co.'s 140-mile line from East Dubuque, Ill., to DesPlaines.

The ICC approval came after final approval of Northern Natural Gas Co.'s plan to furnish 50 MMcf of gas daily to NI-Gas.

The new supply from Northern Natural makes it possible for Northern Illinois to mail househeat permits to 41,500 customers. The recent approval of the Midwestern plan to deliver 60 MMcf daily to Northern Illinois will go a long way towards clearing up the company's remaining waiting list, numbering about 60,000.

Pakistan may export gas

The possibility of liquefying natural gas and transporting it from Pakistan to Japan is apparently being explored by representatives of Constock International Methane Ltd.

An American team, composed of Adm. Arthur W. Radford, F. E. Battson and J. A. Murphy, spent some time recently in Karachi with Pakistani government officials. Their visit included a tour of the Sui gas fields.

It was reported that the Constock group found a ready response for the gas in Japan. Australia and South Africa also were mentioned as possible markets for the liquefied natural gas.

Transco gas sale okayed despite coal opposition

An FPC presiding examiner has okayed the sale of additional gas by Transcontinental Gas Pipe Line Corp. to seven existing customers. In the same case (Docket G-16466 et al), the emergency exchange of gas between Transco and Texas Gas Transmission Corp. was approved.

Transco's sales of the 50 MMcf per day are now being made under a temporary certificate issued last November.

Coal interests opposed Transco's plan, claiming that since the heating season is over the only use which can be made of the limited-term firm gas by the companies is to "dump the gas into industrial or utility boilers." Presiding Examiner Purdue found, however, that if it was "not physically possible or financially feasible" for Transco to store the gas between now and next November, the company "is . . . entitled to sell all of the same for ultimate consumption as boiler fuel."

Boiler fuel sale authorized

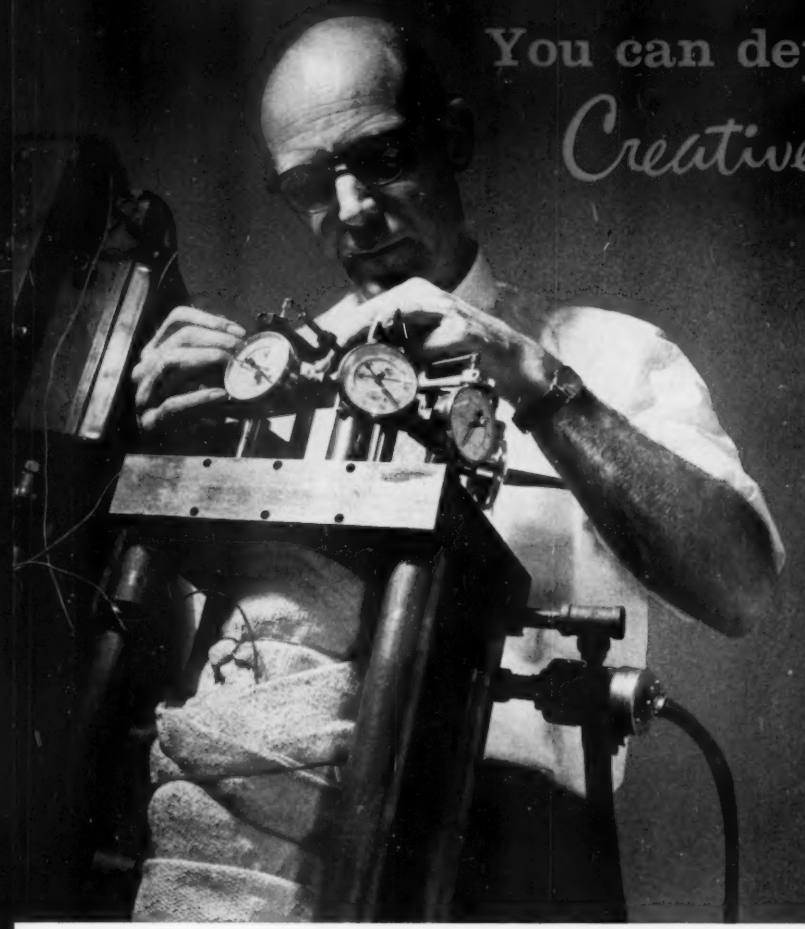
A step toward relieving the air pollution problem of southern California was taken recently when the FPC okayed the sale of gas by El Paso Natural Gas Co. to Southern California Edison Co.

El Paso will build facilities (Docket G-12580) in order to supply a maximum of 100 MMcf daily to the Edison company for use in its steam electric power plants and to Southern California and Southern Counties Gas companies for their peaking service.

The proceeding was partly decided by the FPC in March 1958. At that time, El Paso was authorized to build only the facilities needed for it to connect new sources of gas supply. The remainder of the case was remanded to Presiding Examiner Samuel Binder to determine, among other things, El Paso's ability to supply natural gas for the proposed service.

In his 73-page decision, Binder concluded that the FPC staff probably had understated El Paso's reserves while the company appeared to have overstated them. The main dispute, he said, was over the volume of gas supply deliverable from the Mesa Verde and Pictured Cliffs fields in the San Juan basin.

The examiner said the problem was to arrive at a "reasonable estimate" by balancing the staff's possible understatement against El Paso's overstatement. Using an "average well" approach, he estimated total remaining recoverable reserves dedicated to El Paso in the two fields at 7 trillion cu ft. This estimate "may be optimistic," he said, and is no more "than an approximation." In any further proceedings involving the two fields, Examiner Binder said the matter should be approached on the basis of detailed information as to each and every well in these fields rather than on an average well approach.



You can depend on W-K-M's *Creative Engineering*

W-K-M Through-Conduit Gate Valves for Oilfield Service
Catalog 200

W-K-M Through-Conduit Gate Valves (ASA)
Catalog 300

ACF Lubricated Plug Valves (Semi-Steel)
Catalog 400
(Steel)
Catalog 1100

ACF Non-Lubricated Ball Valves
Catalog 1000

KEY Refinery Fittings and Return Bends
Bulletin KR-1257

KEY-KAST Alloy Welding Fittings
Bulletin KK-1057

KEY Pipe Joint Compounds
Circulars 239-B and 240-B

W-K-M Slips and Spiders
Catalog 200

W-K-M creative engineering gives you the benefits of continuous research and development . . . of skill and care in production . . . of thorough testing, in the laboratory and in the field.

W-K-M's leadership in its special fields results from research into your most difficult problems and the development of practical solutions that meet the most exacting demands of performance, easy operation and economy.

W-K-M design, materials and workmanship establish quality standards that are rarely equaled, never surpassed. Testing is continuous and rigorous.

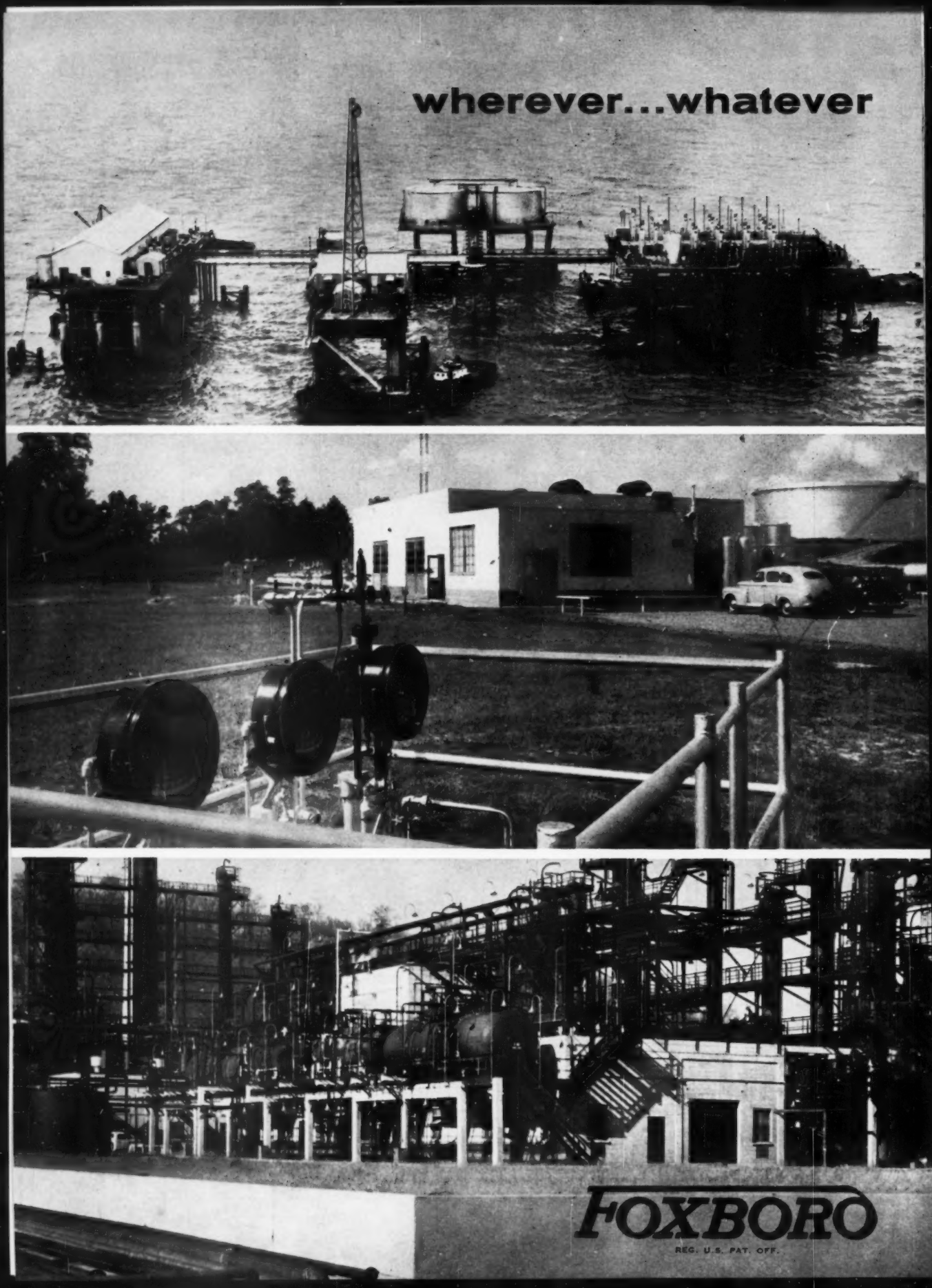
Specify W-K-M with confidence—*you can depend on W-K-M's creative engineering.* For complete information covering W-K-M products, write for the literature indicated at right.

Engineered for Dependability and Long-Range Economy

W-K-M Division of ACF Industries, Incorporated,
P. O. Box 2117, Houston 1, Texas

W-K-M SERVING INDUSTRY 40 YEARS

W-K-M, ACF, KEY, KEY-KAST
are registered trademarks of ACF Industries, Incorporated


wherever...whatever
FOXBORO
REG. U.S. PAT. OFF.

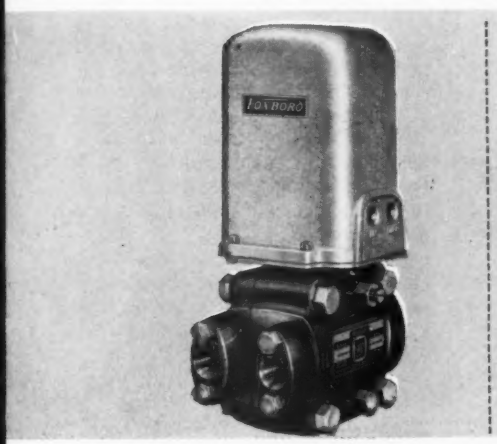
your flow problem

FOXBORO HAS A BETTER INSTRUMENT FOR IT

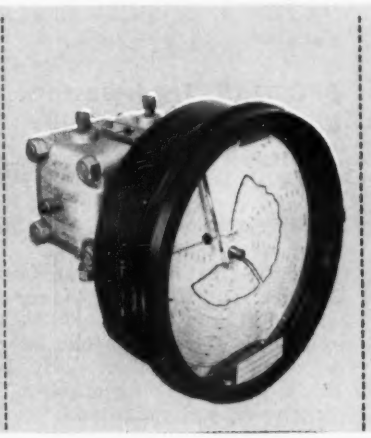
Liquid, vapor, gas, or slurry—there's a Foxboro instrument to meter the flow of any fluid in any oil and gas process. From the simplest general utility meter, to complex automatic ratio control systems, Foxboro offers the greatest variety of flow measurement and control equipment, assuring you of the right instrument for every flow problem.

Foxboro meters include superior accuracy, "cashregister" flow recorders; portable types for field checking; transmitters for long-distance, centralized control; as well as specially designed flow systems for even the most unusual needs.

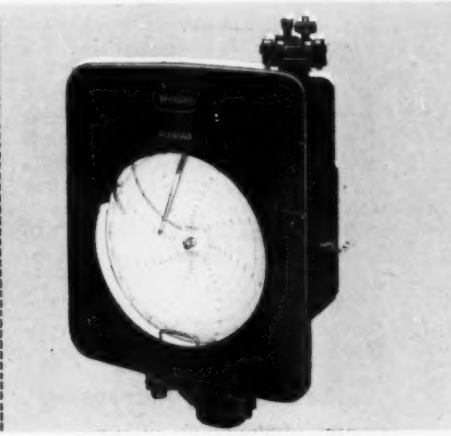
A few of these meters are described below. For complete information on these, or any meter in Foxboro's complete line of flow instrumentation, get in touch with your nearby Foxboro Field Engineer. Or write **The Foxboro Company, 347 Norfolk St., Foxboro, Mass.**



d/p CELL FLOW TRANSMITTER. Provides high sustained accuracy with positive overrange protection—complete line includes both pneumatic and tubeless electronic transmitters.



DIAPHRAGM METER. Uses no mercury—inherently linear, with NO zero drift. Round and rectangular cases. Available also as pneumatic or tubeless electronic transmitter.



MERCURY METER. Wide variety of types. Type 28 Meter, shown above, is ideal for gas flow metering. It has the longest float travel and the most power of any commercial meter made.

OTHER FOXBORO FLOW INSTRUMENTATION: Magnetic Flow Meters • Panel-, field-, and valve-mounted flow controllers • Electric, Pneumatic, and Mechanical Integrators • Planimeters • All primary elements, valves, and accessories required for complete flow measurement and control systems.

FIRST IN *FLOW*

New engine to power remote control station

Columbia Gulf Transmission Co.'s recently announced experimental remote-control compressor unit has been sanctioned by FPC. Installation will be at the Hampshire, Tenn., compressor station (see GAS Highlights, June, p. 8).

Principal components of the installation are: A newly developed Clark 10-cylinder, two-cycle V-engine rated at 4000 hp; a Westinghouse speed increasing gear of lock-train design; and a conventional Clark 24 by 24 centrifugal compressor.

Columbia Gulf President John W. Kelley said the experiment is being conducted to determine the economic advantages of such an installation. When it applied to the FPC (Docket G-18121), Columbia Gulf said that no similar two-cycle centrifugal combination is at present being operated by any gas transmission company.

The new turbocharged engine has been a year and a half in development and has been on test in Olean, N. Y., since Feb. 15. F. W. Laverty, president of Clark, said it will combine low fuel consumption with the known reliability and low maintenance costs of two-cycle units, and that it will develop approximately 40 per cent thermal efficiency.

The experimental installation, built by Clark, is being cooperatively designed by Columbia Gulf and Gulf Interstate Co. Columbia Gulf has an exclusive option to buy the complete unit.

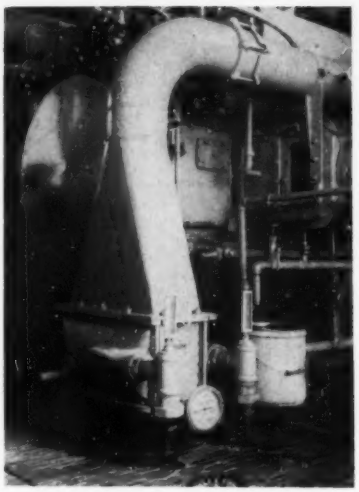
The $1.6 million installation is to be completely automatic in operation. It will be controlled remotely from the Columbia Gulf gas control center on the 22nd floor of the L&C Tower in Nashville.

Turbocharging increasing compressor horsepower

Nearly 9000 hp has been added to Richfield Oil Corp.'s gas compression facilities in California by turbocharging some 30 Clark gas engine compressors.

Nearly half of the units have already been converted using multiple AiResearch turbochargers per engine. More than 120 turbochargers will be operating ultimately in the project when the small, high-production type turbochargers have added a 25 to 35 per cent increase to the normal power ratings of a variety of Clark engine models.

The gas-fueled engine compressors include seven different Clark models. Clark's six-cylinder plants are employing four turbochargers each, the eight-cylinder units have two turbochargers each, and the three-cylinder units have two turbochargers each. One two-cylinder MA-2 unit is operating with a single AiResearch T-14 turbo.



Air from turbochargers passes through AiResearch intercooler (lower center) on the way to the intake manifold of the gas engine. This process decreases air temperature and increases its density.

FPC staff, Transwestern differ on prices, supply

Charges and countercharges have been made by the FPC staff and officials of Transwestern Pipeline Co. over Transwestern's proposed pipeline from Texas to California.

The FPC staff hit Transwestern's plan on two counts: (1) price, which FPC says is at "such levels as to be contrary to public interest"; and (2) supply, which the FPC claims is not "reasonably adequate to support the project."

Transwestern replied that there was "not one shred of evidence that the rates are not just and reasonable." It said field prices in the Permian basin and the Texas-Oklahoma Panhandle will go up regardless of the FPC decision. FPC argued that Transwestern should not be allowed to pay more than 16 cents per Mcf in the Permian basin and 17 cents in the Panhandle. These were comparable prevailing rates, the staff said.

Earlier, the FPC turned down El Paso Natural Gas Co. request that the commission determine whether gas demands in southern California would support both El Paso and Transwestern proposals to serve the area. Also denied was El Paso's alternative request that its application to increase supplies to southern California customers be consolidated with Transwestern's.

"To grant either . . . would result in an unconscionable delay of the Transwestern proceedings," the commission said.

PG&E seeks more storage

Pacific Gas & Electric wants to operate the partially depleted McDonald Island natural gas field in the San Joaquin River delta as an underground storage area. McDonald Island is 10 miles northwest of Stockton, Calif.

Studies show that with installation of additional compressors, PG&E will be able to inject storage gas at a 150 MMcf per day average. With additional wells, withdrawal can be at a maximum rate of 400 MMcf per day. Injection-withdrawal cycle will allow storage of 30 billion cu ft each year.

Piping code reissued

The latest edition of American Standard Code for Gas Transmission and Distribution Piping Systems has been approved by the American Standards Association and published by the American Society of Mechanical Engineers.

The new edition of ASA B31.8-1958, brings the code up to date, incorporating many rulings made since 1955 when the first edition of this standard in its enlarged scope was published.

Copies of the revision are available at $2.50 each from the American Standards Association, 70 E. 45th St., New York 17, or from the ASME, 29 W. 39th St., New York 18.

Abandonment denied

FPC Presiding Examiner Kelly turned down Harper Oil Co.'s request to abandon natural gas sales to Cities Service Oil Co., Oklahoma City (Docket G-14456).

Harper sought to abandon the sale of residue gas from its extraction plant in Oklahoma county. FPC authorized the sale in January 1956. Harper proposed to sell the residue gas in intrastate commerce to Oklahoma Resources Development Co. for delivery to an electric generating plant.

More news on page 149

From the desk of **J. L. MARTIN**

Don—

Have you seen these latest figures on cathodic protection costs on pipelines? They're based on one mile of 24" pipe after several years of service—

Coating	Resistance (ohms/sq. ft.)	Installation	Annual Upkeep
Coal Tar Enamel	300,000+	$112.	$33.
"Economy" Enamel	10,000-	$2,140.	$520.

I'm convinced we can hardly afford to use anything but coal tar for our new line.

Let's specify Pitt Chem Modified Coal Tar Enamel. I understand they make top quality products—and back them up with excellent technical field service.

Jim

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

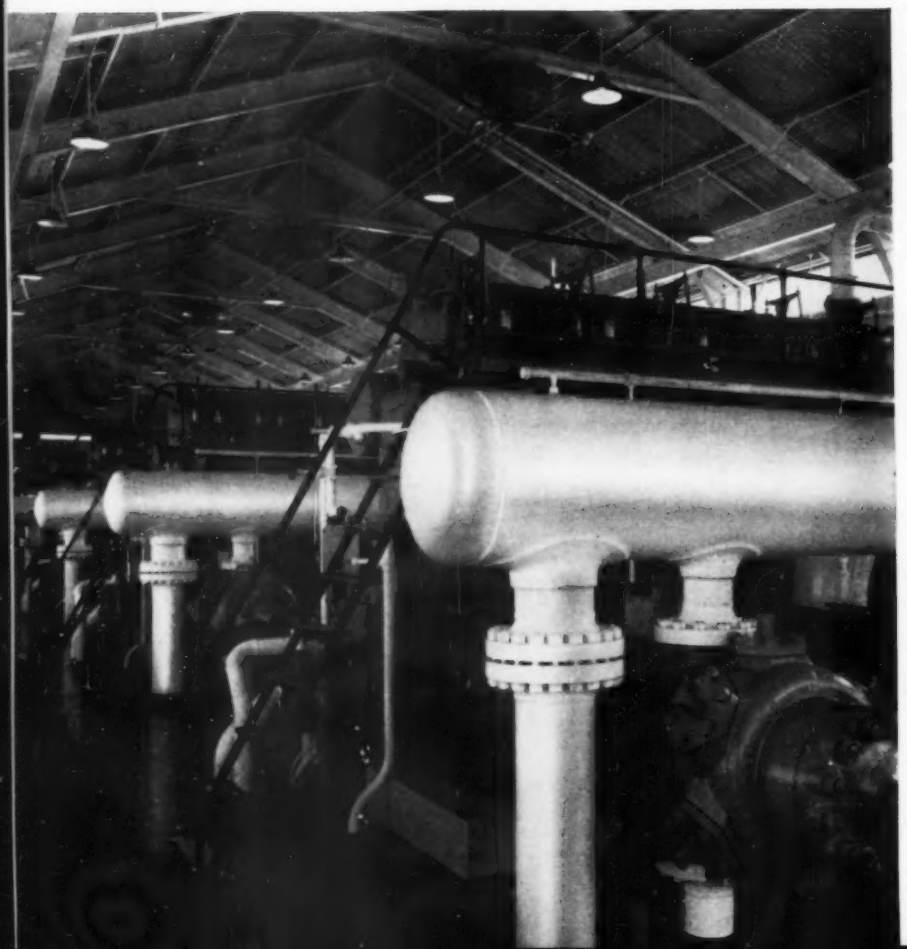
★ PITT CHEM® Coal Tar Pipeline Enamels
★ PITT CHEM "Tarmastic"® Coal Tar Coatings
★ PITT CHEM "Tarset"® Coal Tar-Epoxy Resin Coatings
★ PITT CHEM "Insul-Mastic"® Gilsonite-Asphalt Coatings

WSW 7457

PROTECTIVE COATINGS • COAL CHEMICALS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON • FERROMANGANESE

Station No. 7, at Kemmerer, Wyoming, rated at 5,060 hp, is 7,325 ft above sea level. Mayari R suction and discharge headers and pulsation dampeners are in the foreground.

Bethlehem Compressor Station Stations on the



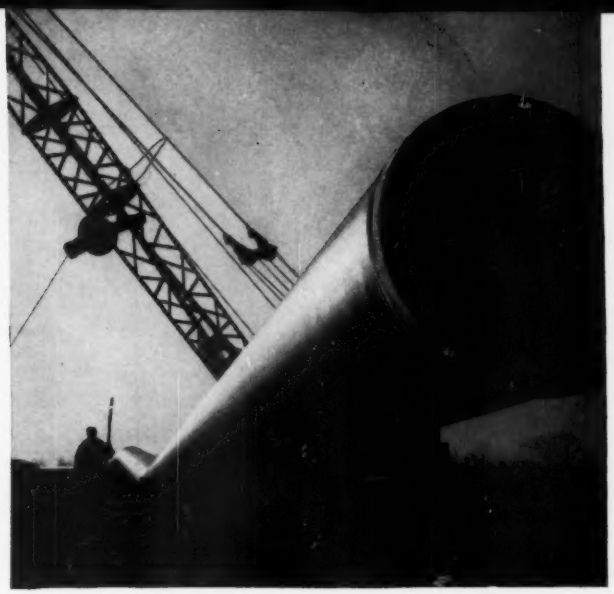
The Pacific Northwest Pipeline

ranks with the most challenging of all pipeline projects—in total length, in size of pipe, in difficulty of the terrain, in severity of weather encountered during construction, and in the speed with which the job was completed. The remarkable success of the planners and constructors in overcoming obstacles is well-known to all pipeliners.

The 1,487-mile main line (26-in. OD) is unusual in that it is supplied at both ends, as well as at various intermediate points. Its southern terminus is at Ignacio, Colorado, in the San Juan Basin. Its northern terminus is at Sumas, on the Canadian border, where it ties in with a line from the Peace river fields. Gas is also delivered from the Piceance Creek and Rangely fields in Colorado, and Wyoming's Big Piney. Laterals bring total length of the line to well over 2,500 miles.

Fish Engineering Corporation handled all of the design, engineering, and station layout work, while Fish Northwest Constructors, Inc., were responsible for construction of the stations as direct agents for the owner, Pacific Northwest Pipeline Corporation.

This is Compressor Station No. 1 at Ignacio, Colorado, with 22-in. OD Mayari R suction and discharge bottles in evidence. Largest station on the system, its seven 2,000-hp units discharge gas to the line at 800 psi.



IN NEW JERSEY—36-in. OD Bethlehem line pipe being installed for a major transmission line. Numerous pipeline companies are already considering the economies of 42-in. pipe now available from Bethlehem.

Pipe Was Used at All Thirteen Pacific Northwest Pipeline

THERE are thirteen compressor stations, totalling 82,780 horsepower, along the 1,487-mile main line of the Pacific Northwest Pipeline. For these vital installations the Fish Engineering Corporation specified Bethlehem's Mayari R compressor station pipe—*exclusively*. It was used in 22-in. and 26-in. sizes for suction and discharge lines, headers, and bottles, and for pulsation dampeners.

Why? Because Mayari R high-strength, low-alloy steel is extremely strong (yield point, 50,000 psi min) and ductile (22 pct min elongation in 2 in.). It's highly recommended for applications subject to high pressures, pulsation, and vibration. And it's readily weldable, too.

Mayari R pipe is available in diameters from 18 in. up. It does not require heat treatment. Bethlehem supplies Mayari R plate to fabricators of elbows, tees, flanges, and other fittings.

Line Pipe to 42 in. OD. At Steelton, Pa., we produce API pipe, electric-fusion-welded and hydraulically expanded, from 18-in. to 42-in. OD, with walls to ¾ in. in all diameters. Electric resistance-weld pipe from 5$\frac{9}{16}$ in. to 16 in. OD, and continuous buttweld pipe from ½-in. to 4-in. nominal, are produced to standard API line pipe specifications on our Sparrows Point, Md., pipe mills.

For more information about Bethlehem line and compressor station pipe, please contact the Bethlehem sales office nearest you. Ask for a copy of our new publication, Booklet 519, containing useful design tables concerning sizes 18 in. to 42 in., inclusive.

IN CALIFORNIA—Lines of Beth-Co-Weld pipe carry product from 24 wells to an automatic trap farm. Many miles of this reliable line pipe are used each year by the oil and gas industries.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

F.H. Maloney COMPANY

IN THE DARK...

ABOUT SCRAPER CUPS?

All Scraper Cups look pretty much alike, particularly today, since the flexible shoulder design pioneered by Maloney Scraper Cups has become standard and widely copied in Scraper Cups.

But Scraper Cups operate in the dark, where looks don't count, and performance does. It is at the end of the run, in the receiving barrel, where performance shows up.

Tough rubber compounds, outstanding physical design, and consistency in production — all are features of the Maloney Scraper Cup that insure top performance in run after run.

Write today for full descriptive literature and the name of the nearest Maloney distributor. Available immediately for fast shipment — to fill your needs. See the light—specify "Maloney."

"Something From The Irishman"

P. O. BOX 1777 • HOUSTON 1, TEXAS
CHICAGO • LOS ANGELES • PITTSBURGH • TULSA

GAS CALENDAR

August

24-26..Appalachian Gas Measurement Short Course—West Virginia University, Morgantown.
26-28..Mid-West Gas Association Gas School & Conference—Iowa State College, Ames, Iowa.

September

4..New Jersey Gas Association Annual Convention—Berkeley-Carteret Hotel, Asbury Park, N. J.
9-11..Pacific Coast Gas Association Annual Meeting—Ambassador Hotel, Los Angeles.
14-18..AGA Industrial Gas School—Penn-Sheraton Hotel, Pittsburgh.
15-16..AGA Accident Prevention Conference—Dinkler Plaza Hotel, Atlanta, Ga.
17-18..AGA Great Lakes Public Relations Workshop—Dearborn Inn., Dearborn, Mich.
24..NEGA Safety Conference—Sheraton Plaza, Boston

October

5-7..American Gas Association Annual Convention—Conrad Hilton Hotel, Chicago.
8-9..California Natural Gasoline Association Annual Fall Meeting—Huntington-Sheraton Hotel, Pasadena.
13-14..Gas Measurement Institute—National Guard Armory, Liberal, Kan.
14-16..Wisconsin Utilities Association Operating & Sales Convention—Shroeder Hotel, Milwaukee.
26-27..Independent Natural Gas Association of America Annual Meeting—Westward Ho Hotel, Phoenix, Ariz.
29-30..Oil Recovery Symposium on Southwest Texas (Sponsored by Southwest Section of AIME and Texas Petroleum Research Committee)—Driscoll Hotel, Corpus Christi, Texas.

February 1960

29-Mar. 2..AGA General Management Section Conference—Pittsburgh-Hilton Hotel, Pittsburgh, Pa.

March

14-18..National Association of Corrosion Engineers Annual Convention—Dallas.
21-23..Mid-West Gas Association Annual Meeting—Hotel St. Paul, St. Paul, Minn.
24-25..New England Gas Association Annual Meeting—Hotel Statler, Boston.
30-April 1..GAMA Annual Meeting—The Greenbrier, White Sulphur Springs, W. Va.

April

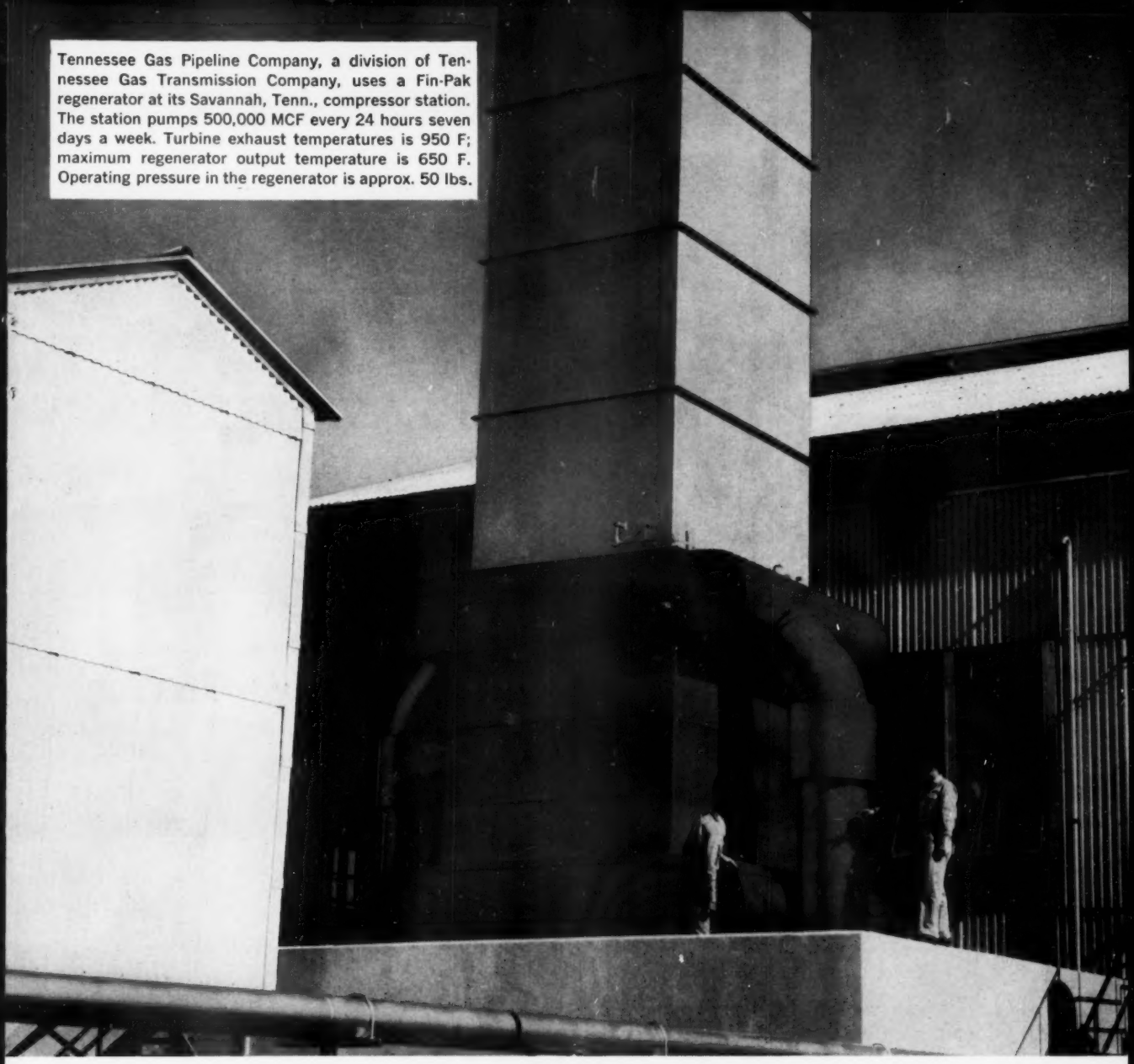
20-22..Indiana Gas Association—French Lick-Sheraton Hotel, French Lick, Ind.
25-27..Southern Gas Association Annual Convention—Galveston, Texas.

May

9-13..AGA Operation Section, Joint Distribution and Transmission Conference—Hotels Roosevelt and Jung, New Orleans.
16-18..AGA-Mid-West Regional Gas Sales Conference—Edgewater Beach Hotel, Chicago.
23-25..AGA Operating Section Production Conference—Hotel Roosevelt, New York.
26-27..Natural Gas & Petroleum Association of Canada—Niagara Falls, Ont., Canada

June

22-25..Canadian Gas Association Annual Meeting—Manoir Richelieu Hotel, Murray Bay, Quebec.
27-28..Michigan Gas Association—Grand Hotel, Mackinac Island, Mich.



Tennessee Gas Pipeline Company, a division of Tennessee Gas Transmission Company, uses a Fin-Pak regenerator at its Savannah, Tenn., compressor station. The station pumps 500,000 MCF every 24 hours seven days a week. Turbine exhaust temperatures is 950 F; maximum regenerator output temperature is 650 F. Operating pressure in the regenerator is approx. 50 lbs.

FIN-PAK HEAT EXCHANGER CUTS FUEL COSTS 32%

An Air Preheater Fin-Pak can pay for itself in approximately 6 months *on fuel savings alone.* For example, a Fin-Pak with a designed effectiveness of 75%, in a gas turbine cycle at 6 to 1 pressure, and a turbine inlet temperature of 1500°F, can cut fuel costs by 32%. And the improved combustion you get with a Fin-Pak reduces residual carbon deposits, cuts maintenance of other equipment in the system.

Fin-Pak provides big installation savings, too. It's compact (takes less than half the space of tubular regenerators of identical capacity) and weighs 50% less than an equally efficient tubular unit — so it's easier to erect and needs less expensive support structure.

No maintenance is required, other than infrequent cleaning with compressed air. The Fin-Pak has short, straight-through passages that facilitate cleaning.

ONE LAST THOUGHT: A gas turbine station requires approximately 80% *less* plant maintenance personnel than a station of equal capacity operating with diesels, steam turbines or gas engines. You can economize still further by incorporating a Fin-Pak in the gas turbine cycle. For complete details, call or write The Air Preheater Corporation.

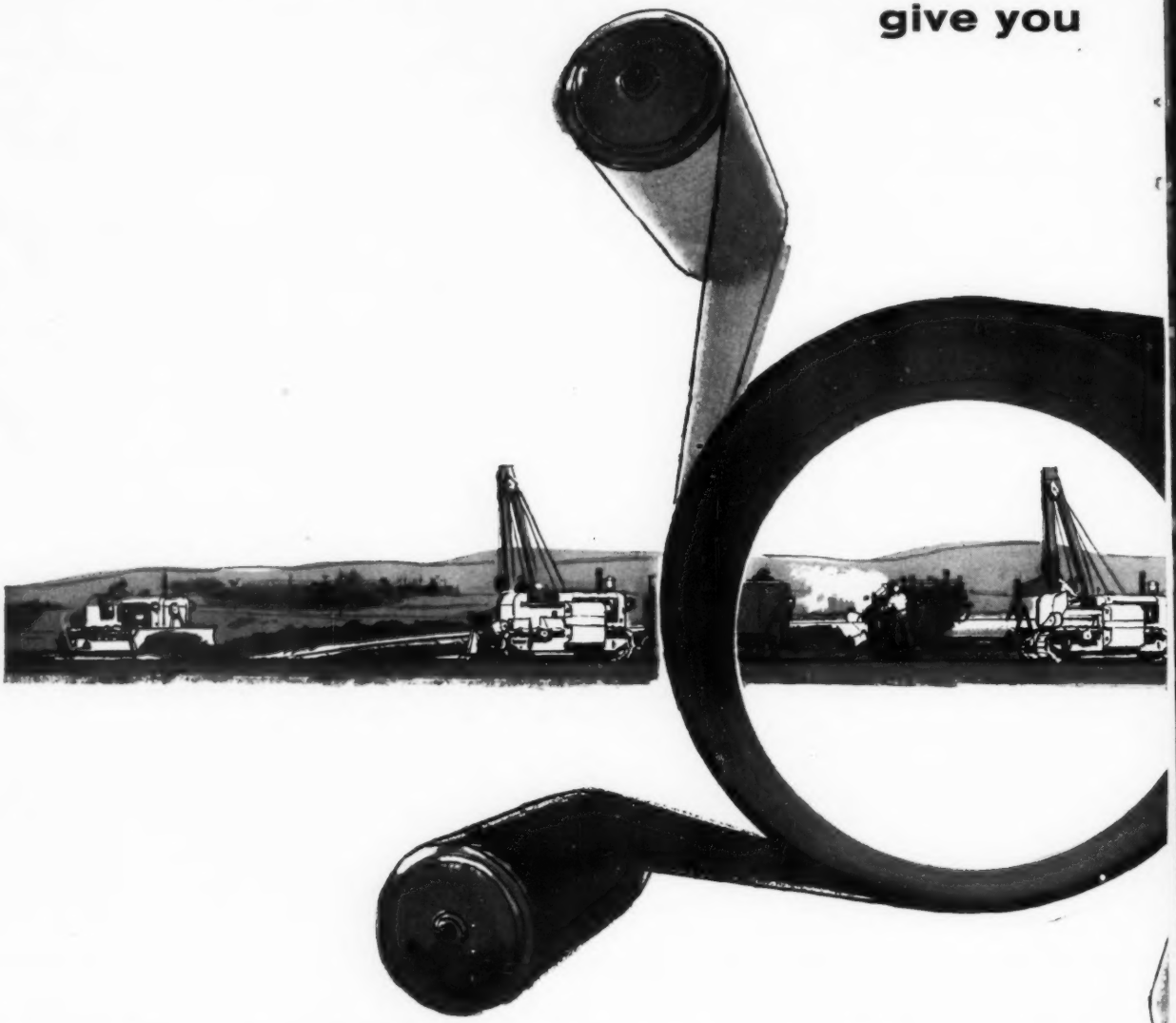
THE AIR PREHEATER CORPORATION

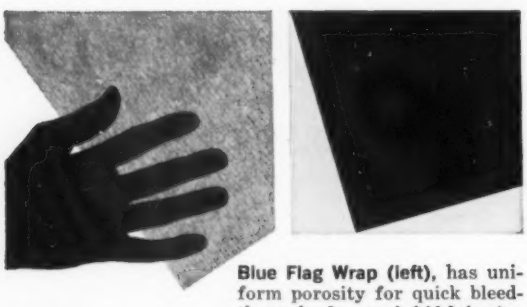
60 East 42nd Street, New York 17, N. Y.

Now...partners in

Blue Flag Fiber Glass

give you





Blue Flag Wrap (left), has uniform porosity for quick bleed-through of enamel. **J-M Asbestos Felt (right),** saturated with coal tar or asphalt, provides a tough outer shell...3 types for field or mill wrapping.

Buyers of pipeline wraps and tapes are now served by an enlarged staff of Johns-Manville sales and technical personnel operating out of 56 sales offices . . . by expanded distribution facilities . . . by the addition of 7 strategically located plants . . . and by expanded research and product development laboratories. For further information, write Johns-Manville, Box 158, New York 16, N.Y. In Canada, Port Credit, Ontario.

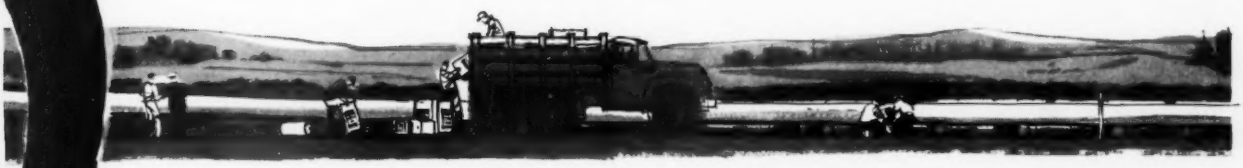
pipeline protection

and Johns-Manville Asbestos Felt join to one responsibility for a better job

...1 For enamel reinforcement

J-M Blue Flag® Wrap—specially formulated from borosilicate type fiber glass—strengthens pipeline enamels the way steel rods reinforce concrete. It reduces cracking and deformation of the enamel. The inorganic fiber glass can't rot, decay or absorb moisture in the ground . . . will add years of protective life to pipeline enamels.

The uniform porosity of Blue Flag allows the enamel to bleed through quickly. It minimizes holidays and helps form an evenly distributed coating with high resistance to soil stresses.



...2 For a tough outer shell

J-M Asbestos Felts, made of fibrous stone, provide a tough, durable outer shell. During the manufacture—natural asbestos mineral fibers are felted, then impregnated with coal tar or asphalt saturant to provide, literally, "a flexible covering of stone."

This outer shell of asbestos protects the enamel against soil stress, earth movement and rock pressures. It resists damage from handling, backfilling, other hazards of installation.

Inert, inorganic asbestos fiber has been uniquely inured by nature over millions of years against rot or decay. Asbestos comes from the ground, is always at home in the ground.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

Edited by FRANK CHAPMAN

Redundancy in communication

By F. VINTON LONG

JAMES H. S. CHIN of Sperry Gyroscope Co. recently brought out some interesting material in *Signal* magazine, journal of the Armed Forces Communications and Electronics Association. Some of his facts might shake up some of us in the communications and telecontrol field. For instance, he quotes in part from the Department of Defense, which says: "It is imperative that electronic equipment be reliable, but it is not. For example, a study made in 1950 showed that only 33 per cent of Navy electronic equipment was operating satisfactorily and later reports indicated that the situation was worse. . . ."

Like the military, pipeline electronic equipment is repeatedly increasing in size and complexity, and as the state of the art advances, performance requirements of this equipment become more numerous and more difficult to meet and, therefore, complexity is unavoidable.

This means that the equipment must be reliable, and in a pipeline telecontrol system the chain is only as strong as its weakest link and any compromise in equipment reliability directly jeopardizes the successful operation of the line. A lot of pipeliners will ask, "Just what do we mean by the word 'reliability'?" Actually it is used rather nebulously, as some consider it to mean the ratio of system "ON" time to "ON" plus "DOWN" time; others believe it to be the number of failures occurring in a given period of time, while still others consider it to be a function of the maintenance time required to obtain a given number of hours of operation.

Wide acceptance is being given today to the Electronic Industries Association's definition, which reads as follows: "Reliability is the probability of a device performing its purpose adequately for the period of time intended under the operating conditions encountered."

Some requirements of communications equipment call for extreme reliability over a very short period of time. An example of this would be a missile.

Pipeline requirements are quite different, as this gear must go on operating year after year without excessive down-time and maintenance cost.

All of us have preached for simplicity in pipeline electronics and we have looked at the several conventional methods which can be employed to enhance equipment reliability. They include: (1) vacuum tube improvement, (2) transistorization, (3) single element redundancy.

Improving vacuum tube operation and upgrading the life characteristics of tubes will help some, but it has been found that if you can improve it by a factor of 2, you are doing quite well. From the standpoint of over-all system reliability, a Q (reliability improvement factor) of 2 represents very little improvement and, therefore, an all-out vacuum tube and component improvement program yields only a slight improvement in over-all system operation.

However, there is some promise

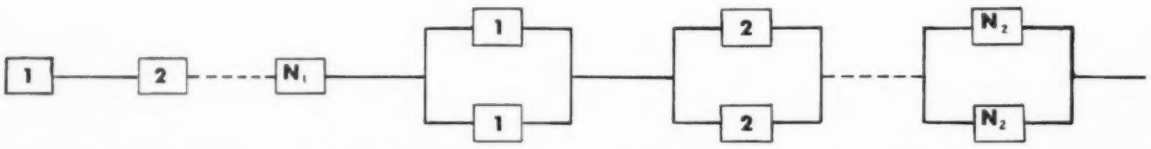


Fig. 1. A partially single-element redundant system uses duplicate elements operating in parallel. Use of this method limits improvement in reliability, since failure of any non-redundant element can bring about immediate system failure.

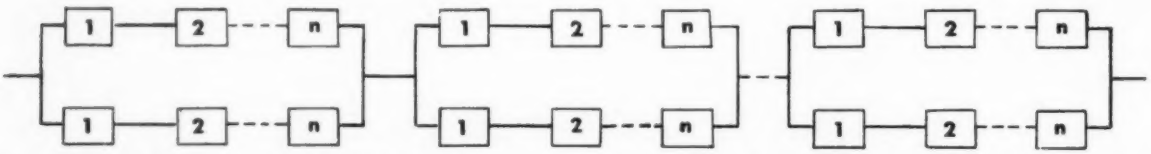
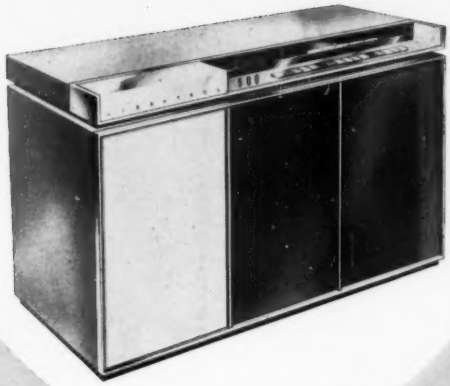


Fig. 2. A group redundant system combines single elements in logical units (groups) which are operated in parallel. This approach provides a high reliability improvement without the effort involved in the single element redundancy approach.



GPE Controls

LIBRATROL·500

...the complete digital process control computer packaged for on-line applications

The LIBRATROL-500 is the equivalent of a 3-shift engineering staff, available to analyze and/or control every function of your plant, for continuous improvement of productivity, cost, and product quality.

Most modern process control systems can utilize the GPE Controls LIBRATROL-500 for logging, supervisory or closed-loop control – at little additional cost. This is because the basic standard LIBRATROL-500 package is *complete* – including input and output, scanning, computing, and logging functions tailored to process control requirements.

The LIBRATROL-500 digital control computer is priced at $84,500 complete. Other models also made by Librascope are available.

Write for complete details about the **GPE Controls LIBRATROL–500** and its application to process control systems

Specifications of Standard

LIBRATROL·500

PROCESS CONTROL COMPUTER

INPUTS

Continuous multiple-switched electrical signals from temperature, pressure, flow, composition, pH, etc.
QUICK ACCESS LOOP: 64-word recirculating register for parallel input, computation, and output.
SPEED: 66 samples per second.
NUMBER: 8, expandable to 512 with additional optional plug-in components.
SEQUENCE: By computer command; changeable by program.
VOLTAGE RANGE: 0-1 and 0-10 (or more) volts d.c.
MANUAL: Flexowriter and punched paper tape.
DIGITAL CLOCK: Internal, pure binary, real time to provide time of day for logging.

OUTPUTS

Flexowriter and punched paper tape; and computer logic producing 10-bit addressable word to actuate relays for control signals.
SPEED AND NUMBER: 66 outputs per second; time-sharing permits unlimited number.
SEQUENCE: By computer command; changeable by program.
TIME READOUT: From digital clock.
TYPICAL OPTIONAL CONTROL FUNCTIONS AVAILABLE: Alarms, voltage level, bridge balance, relay closure, setpoint, reset rate, proportional band, variable time delay, recorder, plotter.

GENERAL SPECIFICATIONS

COMPUTER TYPE: General-purpose digital.
NUMBER BASE: Binary.
MODE OF OPERATION: Serial.
INSTRUCTION TYPE: Single address.
NUMBER OF DIFFERENT INSTRUCTIONS: 16
MEMORY TYPE: Magnetic drum.
MEMORY CAPACITY: 4096 words.
WORD LENGTH: 30 bits plus sign.
CLOCK FREQUENCY: 136 KC
ADD TIME (Excluding Access): 0.25 milliseconds.
MULTIPLY TIME (Excluding Access): 15 milliseconds.
WEIGHT: 1000 lbs. nominal.
SIZE: 30″ x 42″ x 60″.
POWER REQUIREMENTS: 117 volts (±10%) 17 amperes 60 cycles.

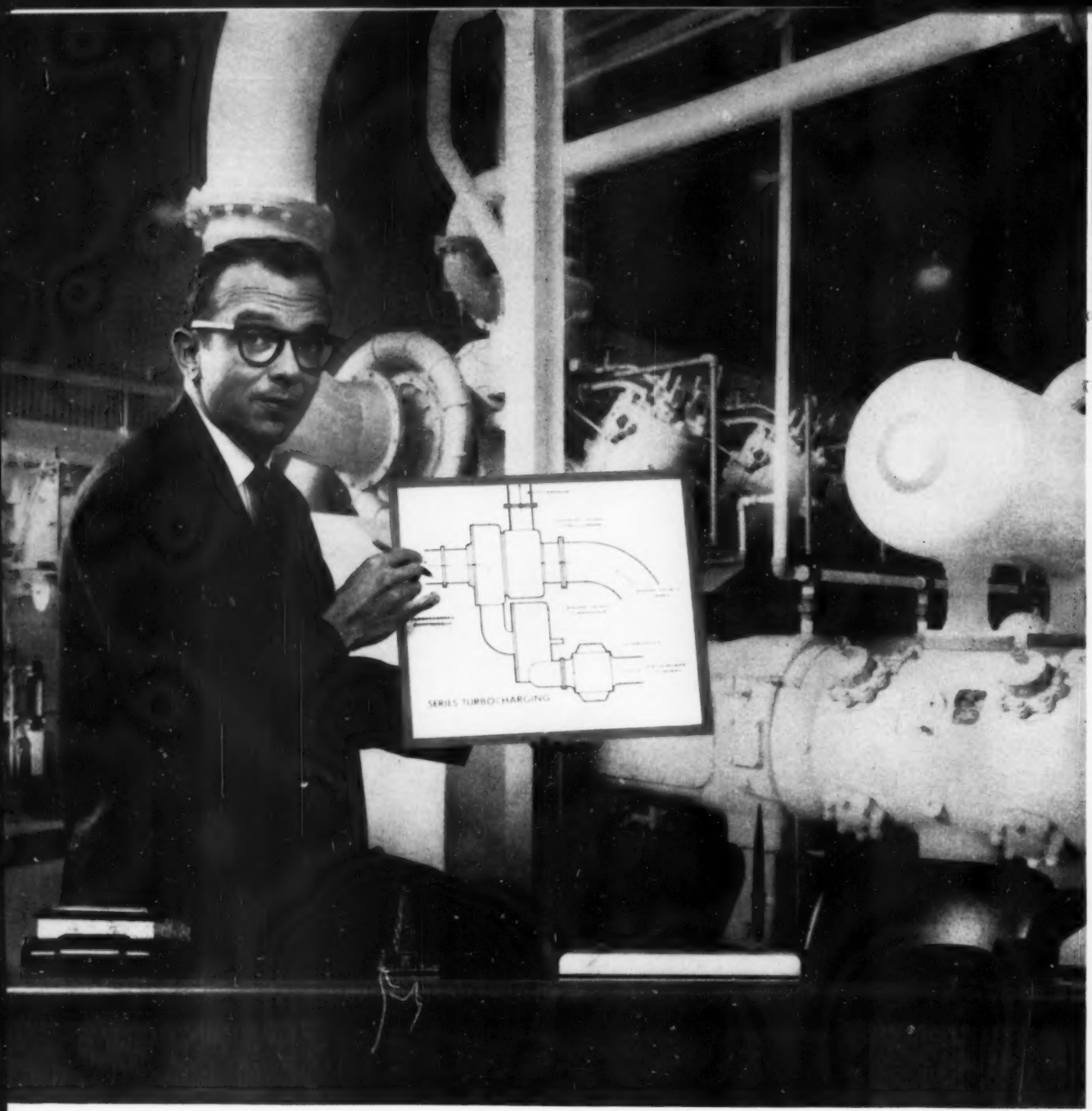
OPTIONAL EQUIPMENT

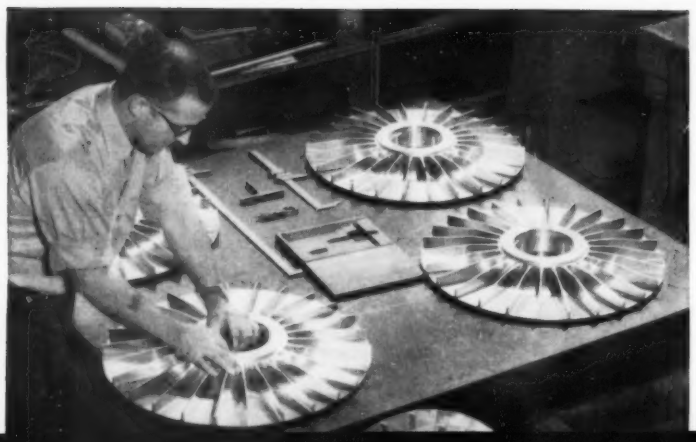
PHOTOELECTRIC READER: High-speed punched paper tape input for buffer storage.
MAGNETIC TAPE: Storage for additional input, output, and computing information.
MAGNETIC-CORE MEMORY: For quick access to stored data.
PUNCHED CARD INPUT.
LINE PRINTER: High speed data-logger printing 14 digits at a time.
TYPEWRITER SELECTOR: For multi-station printout.
RELAY SENSING EQUIPMENT: For changing computer program in accordance with plant or product requirements.
GRAPHIC PANELS: For visual display of information.
CONSTANTS PANEL: Manual digital data insertion or readout for operation by non-technical personnel.

GPE Controls | A GENERAL PRECISION COMPANY

GPE Controls, Inc. (formerly Askania Regulator Company)
240 East Ontario Street • Chicago 11, Illinois

A Subsidiary of GENERAL PRECISION EQUIPMENT CORPORATION





Built Entirely By Cooper-Bessemer. Cooper-Bessemer is able to ideally integrate turbocharger system and compressor engine performance . . . and to assure highest standards of materials and workmanship for these precision components.

Donald L. Reed, *Manager Gas Engine Compressor Sales, The Cooper-Bessemer Corporation, explains . . .*

How you get 40% more power with the latest Cooper-Bessemer V-Angle Compressors

The diagram explains Cooper-Bessemer's series turbocharging development. A step beyond ordinary turbocharging, *series turbocharging* assures an extra performance margin throughout the operating range, plus these unmatched advantages:

40% greater horsepower than predecessors of the same bore, stroke and speed.

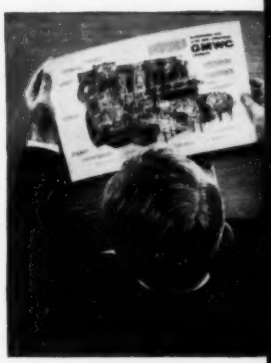
Reduced fuel consumption . . . as low as 6900 Btu/bhp/hr—proof of series turbocharging's greater efficiency.

Space savings. Greater output, combined with inherent compactness of V-angle design, results in lowest cost per horsepower for housing, foundation, piping, maintenance, supervision.

Superior altitude performance. Inherent flexibility of the series turbocharging system allows unique altitude compensation to assure full rated horsepower and highest efficiency.

Full range response. The Cooper-Bessemer series turbocharging principle *automatically* provides optimum supercharging regardless of the degree of load.

WRITE FOR BULLETINS . . . complete details on Cooper-Bessemer Series Turbocharged V-Angle Compressors in GMVC Bulletin 85 and GMWC Bulletin 86. Free on request.



Latest Bulletins. GMVC Bulletin 85, 1100 to 1800 bhp; GMWC Bulletin 86, 2000 to 3500 bhp.

BRANCH OFFICES: Grove City • New York • Chicago • Washington • San Francisco Los Angeles • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis • New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd. . . . Edmonton • Calgary Toronto • Halifax

Cooper-Bessemer International Corporation . . . New York • Caracas • Mexico City

C-B Southern, Inc. . . . Houston

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

FACTORS	RELIABILITY IMPROVEMENT	EXTRA ENG. EFFORT	AUTO FAILURE DETECTION, LOCATION	OTHER ADVANTAGES
CONVENTIONAL EQUIPMENT	NONE	NONE	NONE	
VACUUM TUBE AND COMPONENT IMPROVEMENT				
a. QUALITY IMPROVEMENT	LOW	VERY HIGH	NONE	
b. CKT STANDARDIZATION	LOW	MODERATE	NONE	STANDARDIZED COMPONENTS FEWER SPARE PARTS
TRANSISTORIZATION				
a. 100%	LOW	VERY HIGH	NONE	LESS SPACE, WEIGHT LESS POWER REQUIRED LESS HEAT DISSIPATION
b. 30%	LOW	MODERATE	NONE	
SINGLE ELEMENT REDUNDANCY				
a. 50%	LOW	MODERATE	FAIR	
b. 90%	MODERATE	HIGH	GOOD	
c. 100%	VERY HIGH	VERY HIGH	EXCELLENT	
GROUP REDUNDANCY				
a. n = 5	VERY HIGH	HIGH	EXCELLENT	
b. n = 20	HIGH	LOW	GOOD	
c. n = 40	MODERATE	VERY LOW	FAIR	
d. n = 100	MODERATE	VERY LOW	FAIR	

Fig. 3.

in the new cathode tube developments which might help our troubles a lot, but apparently it will be several years before these tubes are available.

The other component improvement might be the use of transistors instead of tubes and the trend has been growing at a rapid rate. There have been claims of expected transistor life as high as one million hours, which is many times as high as that of a vacuum tube. However, the reliability of either tube or transistor is only one of the factors that contribute to the reliability of an entire system.

Investigations have indicated that in typical electronic equipment, vacuum tubes represent 15 per cent of part population and account for 67 per cent of all failures reported. This means that all other components, such as resistors, relays, etc., represent 33 per cent of the failures. You might conclude from this that even if a tube or transistor was 100 per cent reliable, the failure rate would be reduced by a factor of 3. The gimmick, though, is that there are no tubes or transistors which are 100 per cent reliable, so that the whole thing requires a little closer look.

One approach to better operation is the use of a redundant system. In this case the term "redundancy" is the use of parallel components to reduce the probability of failure, and a familiar example is the double headlights on an automobile. The objective is, of course, to minimize the chance of driving in the dark. The same thing can be introduced into electronic equipment, although it may seem surprising that an increase in number of electronic components can decrease the probability of system failure. But this redundancy gimmick does just that. So we assume that the probability of failure of a single component in a microwave system in a given time is 0.001. If this component is made redundant by operating two components in parallel, the possibility of failure of both components is $(0.001)^2$ or 0.000001. Thus by using twice as many components, the probability of failure has been reduced 1000 times and this can be expressed as an improvement factor Q of 1000.

Another thing to be thought of is that if everything is operating in parallel you must at some point understand which one of the parallel circuits is in trouble before the other one goes bad. And, unless this can be located quickly and replaced, the reliability of the system is greatly reduced. This means that it is impractical to use dual components to provide redundancy because the faultfinding equipment will be more complicated than the basic system. An example of a partially single-element redundant system is shown in *Fig. 1*. You will note the failure of elements 1-2 and N_1 will bring about failure of the system.

An example of a group redundant system is shown in *Fig. 2*. You will see that this consists of several groups of paralleled series elements and this approach should provide extreme reliability.

Some idea of the results that should be expected of upgrading or redesigned equipment is shown in *Fig. 3*. This figure is also a device of Mr. Chin's. For example, you will see that a 100 per cent transistorization program requires lots of engineering with low reliability in improvement, compared with the group redundancy column which shows very high reliability of improvement with a minimum of engineering.

What this boils down to in the case of pipeline communications, and particularly for microwave systems, is that if extreme reliability is to be obtained one must brace himself for the cost of a dual system with two transmitters and two receivers operating continuously. ■

corrosion • *Continued*

from page 23

low resistivity medium, which is cited as an example of the wastefulness of the near electrode criterion. As said before, this is a conservative criterion; but the one which involves 0.85 volt to a remote electrode, is not reliably adequate; it will, at times, lead to adequate protection; but it will often lead to gross underprotection. With the near electrode, the opposite is true; it will always lead to protection; but it will sometimes lead to gross overprotection.

The remedy in such case is to use the potential-log current criterion, or the continuous polarity criterion, or the earth current (or a modification thereof) criterion; i. e., to insure that the surface is everywhere receiving current.

It might also be pointed out that remote earth is often the correct location for the electrode when interference effects are being investigated; and even better, where possible, is the use of line current measurements. In the presence of a well-coated line, a near electrode will often show an alarming shift of potential at a crossing, whereas in fact there is little or no current transfer; again this is a mere IR drop effect, exaggerated by the high resistance of good coating. Again, this is quite apart from the criterion for cathodic protection. ■

United gets Texas gas

United Gas Pipe Line Co., Shreveport, can install 14.4 miles of 12-in. pipe and four purchase meter stations to pick up gas in the North Henderson field area of Rusk county, Texas.

In approving Dockets G-15514, 15716, and 16923, Presiding Examiner R. N. Ivins bypassed FPC staff recommendations regarding initial price of the gas. The staff suggested varying prices between 14 and 16 cents, indicating that 15.4 cents would be most appropriate. United's contracts with the producers (Phillips Petroleum and Union Producing) call for an initial price of 17 cents per Mcf.

El Paso boosts supply

Additional gas supplies from Lea county, N. M. will be acquired by El Paso Natural Gas Co. with authorization of its Docket G-15306 and G-15482.

The company will spend $867,000 to add 2200 hp to its Eunice field compressor station, bringing the capacity of this station to 22,100 hp, and install additional metering facilities. El Paso will be able to take about 17.4 MMcf of residue gas daily produced in the South Eunice, Langlie Mattix, Jalmat and San Simon fields in Lea county.

Chicago District builds

Chicago District Pipeline Co.'s $12.9 million plan to move its share of gas from Midwestern Transmission Co. has FPC approval (Docket G-10214).

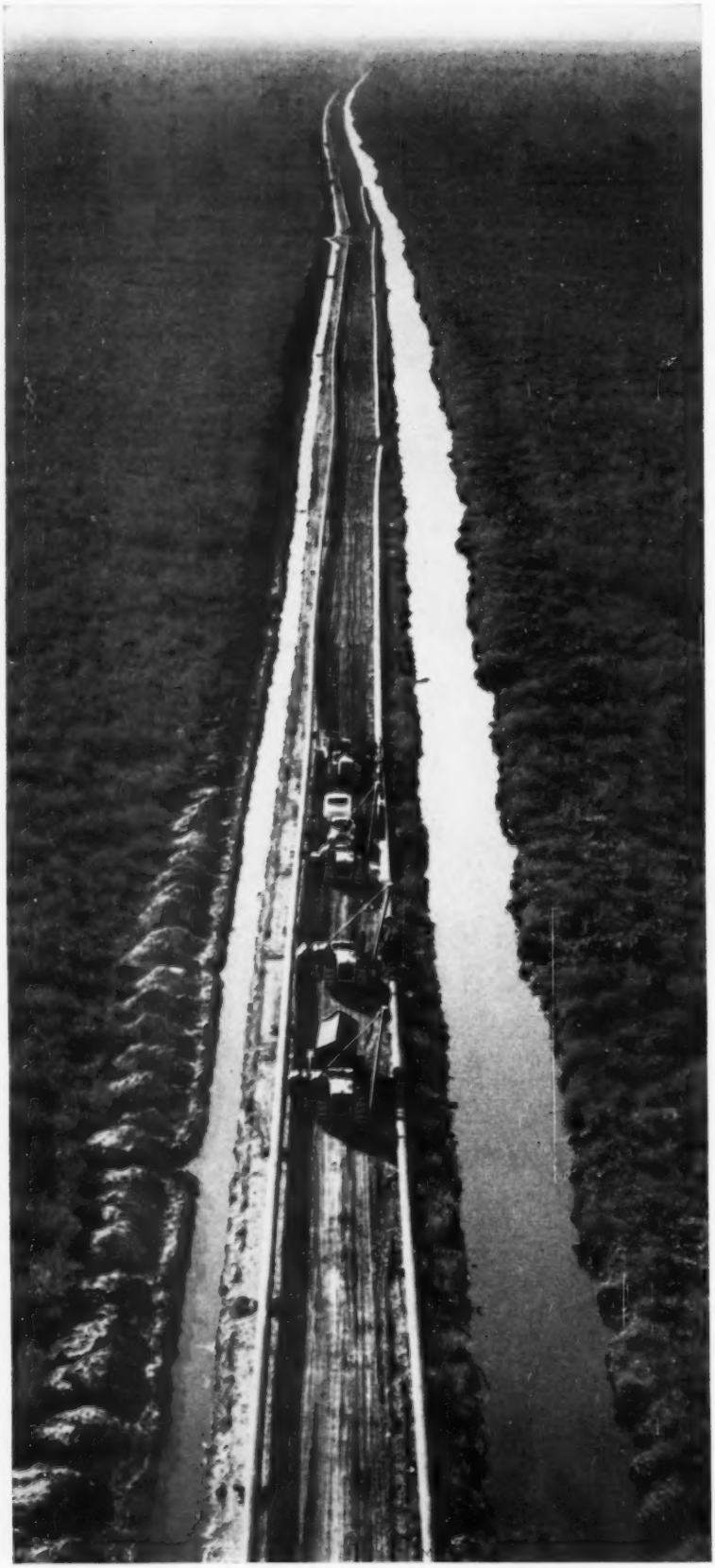
Construction includes some 50 miles of 36-in. mainline paralleling its existing Joliet-Calumet lines to Chicago, 2.3 miles of 30-in. laterals, and control and measurement equipment.

Midwestern's peak-day volume deliveries to Chicago District for redelivery are: Peoples Gas Light & Coke, 100 MMcf; Northern Indiana Public Service, 200 MMcf; and Northern Illinois Gas, 60 MMcf.

GAS • Pipeline Notes

Colorado Interstate Gas Co. has approval of its plan to sell its gas transmission facilities in Colorado's Arkansas valley. Citizens Utilities Co., La Junta, will acquire about

SERVICE IS NO SECRET AT SPI
No secret to our customers for they know through experience that they can count on SPI to make deliveries of perfectly processed pipe where it is wanted and when it is wanted.
And no secret to our employees for everyone at SPI is constantly aware of the fact that their primary assignment is to produce c/w pipe exactly according to SPI's rigid Standard Procedures and to ship it to our customers where and when it is needed.
Count on SPI for service . . .
SP
standard pipeprotection inc.
3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MO.



HOW TO CHECK OUT THE TOUGHEST TAPE EVER WRAPPED AROUND PIPELINE

Give it the works . . . that's what Polyken did to its latest development— Extra Strength No. 960

. . . Run it through every tape durability test a laboratory can apply.

. . . Wrap this rugged tape around 30 miles of 24-inch gas line in the swamp water and coral rock of southern Florida. Let an Iranian oil company use it on 200 miles of desert oil line. Put it to work for the Phillips Petroleum Co. in Texas and Canada.

If a tape coating can stand all this and still do the whole job cheaper than hot dope, you've got something special. Something permanent in pipeline protection—Polyken Extra Strength No. 960 Pipeline Roll.

Available at no extra cost.

Applying Polyken protection, as seen above, the Houston Texas Gas and Oil Corporation laid a 1600-mile gas line from Louisiana to Florida. Polyken saved them $500 per mile by way of less men per job and more miles per day. Tape's ready. No primer, no drying or cooling, no fumes or fire hazard. And *low* equipment cost.

Get the full particulars on Polyken performance and economy from your Polyken representative or write Polyken Sales Division, 309 W. Jackson Blvd., Chicago 6, Ill.

Polyken®

Experienced in modern PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division

POLYKEN PROTECTIVE COATINGS DISTRIBUTORS

Atlanta, Georgia
Steele & Associates, Inc.

Chicago, Illinois
Sales Engineering Inc.

Cincinnati, Ohio
Hare Equipment

Cleveland, Ohio
The Harco Corp.

Denver, Colorado
Patterson Supply

Des Moines, Iowa
Donald Corporation

Fort Worth, Texas
Plastic Engineering & Sales Corp.

Harvey, La.
Allen Cathodic Protection Company, Inc.

Houston, Texas
Cathodic Protection Service

Kansas City, Missouri
Industrial Coatings Engineering Co.

Long Beach, Calif.
Barnes & Delaney

Memphis, Tenn.
General Pipe & Supply Co.

Minneapolis, Minn.
Simcoe Equipment Co.

Philadelphia, Pa.
Harold N. Davis Co.

Plainfield, New Jersey
Stuart Steel Protection Corp.

St. Louis, Missouri
Shutt Process Equipment Co.

San Francisco, Calif.
Incandescent Supply Co.

San Francisco, Calif.
Phillips & Edwards Electric Co.

Seattle, Washington
Farwest Corrosion Control Corp.

Seattle, Washington
Pacific Water Works Supply Co.

Polyken

Experienced in modern PROTECTIVE COATINGS

110 miles of line plus several metering and regulating stations. Citizens will continue to buy gas from Interstate for resale to its present customers. It will also sell gas to four direct-sale customers now served by Interstate.

Harry J. Trainor, assistant Commissioner of Internal Revenue, is succeeding Henry R. Domers as executive director of FPC. Domers, retiring after 4½ years in the post, received upon his retirement the first distinguished service award bestowed by the commission.

Garrett Oil Tools, a division of U. S. Industries Inc., has named Thomas J. Campbell Co., San Francisco, as a sales agent. The Campbell company will handle Garrett equipment in northern California and western Nevada.

Beginning in September, the University of Texas will offer a curriculum leading to a degree in petroleum land management. The study plan is based upon recommendations of the education committee of the American Association of Petroleum Landmen.

United Fuel Gas Co., Charleston, W. Va., has FPC approval of its $2.5 million plan to install 18.5 miles of 26-in. line in Kanawha county, W. Va. Without the line, the company said it would have a deficiency of 47.7 MMcf on an average May day in 1959, increasing to more than 150 MMcf in 1960.

Royston Laboratories Inc., Pittsburgh, Pa., is opening a new sales office in St. Petersburg, Fla, and warehousing facilities in Tampa, Fla. Murray Newell will be the new sales representative for Florida, southern Alabama and southern Georgia.

FPC told Trunkline Gas Co. to sell and deliver gas to the town of Mason, Tenn. in maximum volumes of 185 Mcf per day (Docket G-13659). According to Examiner Law, the demand of Mason is so small compared with the more than 1.2 billion cu ft per day capacity of the combined system of Trunkline and its parent, Panhandle Eastern, that the effect of any action in this case on the reserves or capability of that system is insignificant.

Pipeline People

A. L. Vaughan
Northern

J. O. Grantham
Northern

W. B. Hass
Northern

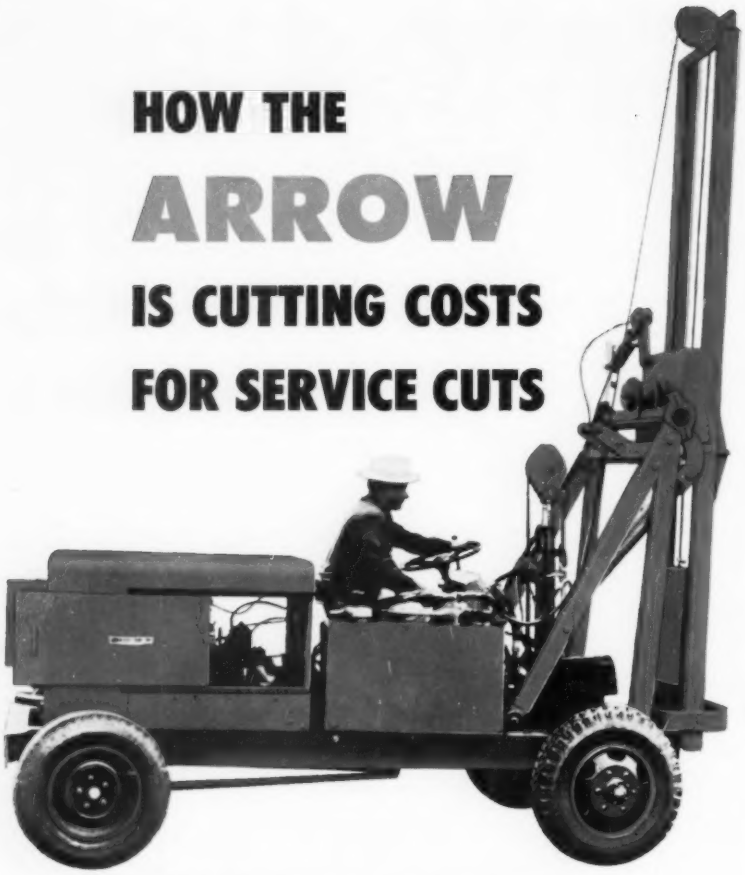
Northern Natural Gas Co., Omaha, has three new vice presidents. They are: A. L. VAUGHAN, vice president in charge of operations, southern region; W. B. HAAS, in charge of northern region operations; and J. O. GRANTHAM, vice president, employee relations. Vaughan and Haas were general managers of the respective regions prior to their election as vice presidents. Grantham was manager of employee relations before his promotion.

DAN L. GARDNER has joined Northern Natural Gas Producing Co. as chief production engineer. Before joining Northern, Gardner was with the Crescent Petroleum Corp. in Tulsa.

ROGER N. STARK has been promoted to eastern sales manager for Tennessee Gas Pipeline Co., a division of Tennessee Gas Transmission Co. Stark will headquarter in Washington, D. C. He formerly was senior sales representative in Houston.

FRANK H. DUNN JR. has been appointed sales manager of the Frank Wheatley Corp., Tulsa.

HOW THE ARROW IS CUTTING COSTS FOR SERVICE CUTS



GAS COMPANIES *in all parts of the country* are realizing substantial savings in making service cuts by using the ARROW Mobile Hydraulic Hammer. One man and an ARROW can do the work of six men using air tools to break concrete, cut asphalt or compact trench backfill... and the ARROW does the job better.

Hydraulically controlled striking power—
The operator of the ARROW Mobile Hydraulic Hammer can set the hammer control upon automatic to deliver blows of uniform impact, up to 8,000 ft.-lbs. Or he can control the hammer manually. Also, he can use the exclusive ARROW creeper-gear to move the machine at uniform speed up to 32 ft. per min. A wide range of quickly interchangeable hammer points and tools makes the ARROW ideal for a wide variety of jobs. The ARROW is constructed to give years of rugged service under constant pounding.

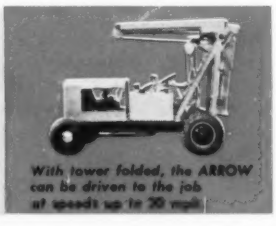
Fast Test Holes For Locating Gas Leaks

A special punch attachment is widely used with the ARROW for making small diameter test holes for locating gas leaks. It quickly penetrates blacktop or concrete, making test holes many times faster than hand operated air tools.

Write Factory for Free Descriptive Brochure

ARROW DENVER

ARROW MANUFACTURING COMPANY
194 West Dakota • Denver 9, Colorado



With tower folded, the ARROW can be driven to the job at speeds up to 20 mph

M. G. Purpus
BS&B

Newton Baker
BS&B

W. R. WOFFORD, superintendent of communications for Texas Gas Transmission Corp., Owensboro, Ky., is the new president of the Petroleum Industry Electrical Association. Serving with Wofford as vice president is C. E. UPSON, Texas Illinois Natural Gas Co., Chicago.

CHARLES D. WOOD of Worthington Corp.'s Boston district office has been appointed district office manager there. He succeeds RICHARD M. CLEVELAND, who is retiring after 42 years with Worthington.

F. ROGER PARKS is vice president in charge of the newly opened New York office of Continental Tube Co., an affiliate of the Crispin Co., Houston.

Black, Sivalls & Bryson Inc., Kansas City, Mo., has elected two new vice presidents. NEWTON D. BAKER takes over the newly created post of marketing vice president. He will continue his responsibility for all advertising, sales promotion and public relations. M. G. PURPUS is vice president and manager of steel products sales. He has been sales manager of the division and also vice president of BS&B International.

IRVING KOSS is manager of the microwave department and industrial control products department of Motorola's communications and industrial electronics division.

New eastern regional sales manager of Pittsburgh Coke & Chemical Co.'s protective coatings division is JOHN E. HIMMELRICH. He succeeds HOWARD F. TRUSLER JR., who has become sales manager of the division's regional office in Houston.

HENRY C. TOOLEY has joined W-K-M, a division of ACF Industries Inc., as plant manager for the Missouri City plant.

I AM A BOTTLE!

Not just *any bottle*, but a USS National Seamless Steel Bottle. Let me give you some facts while I'm being coated. In the first place, I was made by the world's largest manufacturer of tubular products.

What am I used for? Underground gas storage! Down there, grouped with others like me, I'm safe from storms, high winds and lightning. Also, I'm economical. Why? I'm not much of a maintenance problem. I don't have to be painted periodically. And, since I'm underground, there's no danger of my vibrating or settling.

Here's another thing! If I have to be inspected, or need a minor repair, I can be cut off the line without bothering the gas pressure in the remaining groups of bottles.

And, like all National Seamless Bottles, I was pierced from a solid billet of steel. The highest quality steel, I might add. What's more, I was rigidly inspected and went through severe hydrostatic tests before I was finally shipped.

I guess they're just about finished coating me, so, if you'd like to know more about USS National Seamless Steel Bottles, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

The world's largest and most experienced manufacturer of tubular products

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

pipeline people • *Cont'd.*

JAMES J. ROSECKY has been appointed executive vice president of Clark Bros. Co., one of the Dresser Industries. Rosecky, who joined the Olean, N. Y., company in 1957 as vice president-operations, succeeds F. W. LAVERTY, who was recently named president. Rosecky was with Dresser Industries from 1950 to 1952, when he joined Baldwin-Lima-Hamilton Corp. as vice president and general manager of the Eddystone division.

J. J. Rosecky
Clark Bros.

E. G. Hotze
Clark Bros.

J. Y. Allen Jr.
Clark Bros.

J. R. Hutton
Clark Bros.

Clark Bros. Co., Olean, N. Y., has made several appointments in its sales organizations. ERNEST G. HOTZE is now southwest district manager. His territory is composed of Texas (except the Panhandle area), Mississippi, Lousiana, southern Arkansas, and southern New Mexico. Succeeding Hotze as Houston district manager is JOE Y. ALLEN JR. He will be in charge of the Clark Houston and Corpus Christi offices serving the Texas Gulf Coast. Also named as district manager under Hotze is JAMES R. HUTTON, who will be in charge of the newly created Louisiana-Mississippi district.

Permian Basin Pipeline Co. has opened offices in Midland, Texas, with JACK W. SEAMAN as general manager. Also assigned to the Midland office are RICHARD E. MAYNE, serving as manager of staff services in Permian's staff realignment; OTTO BARDEE, manager of plants; and ROY SCHOLLENBARGER, manager of pipelines.

"Chief Roughneck for 1959" is J. L. LATIMER, president of Magnolia Petroleum Co. The Roughneck honor, sponsored by Lone Star Steel Co., was bestowed at the annual TIPRO meeting.

WALTER E. MAX has been named assistant general manager of Worthington Corp.'s compressor and engine division. Succeeding him as manager of manufacturing is HOWARD E. EWELL.

New general sales manager of the engine division of Nordberg Manufacturing Co., Milwaukee, is CARROLL E. DIETLE.

Several appointments were made recently by Youngstown (Ohio) Sheet & Tube Co. ROBERT F. DOOLITTLE has been named general counsel and secretary, succeeding JAMES E. BENNETT, who is retiring from those posts. WILLIAM J. HARNISCH is assistant secretary. LEO DEFIORE has been appointed director of engineering and CARL J. LUCAS chief engineer. DeFiore,

ARE YOU SURE YOUR SYSTEM IS INSULATED?

IT'S EASY TO

check for shorts with the NEW

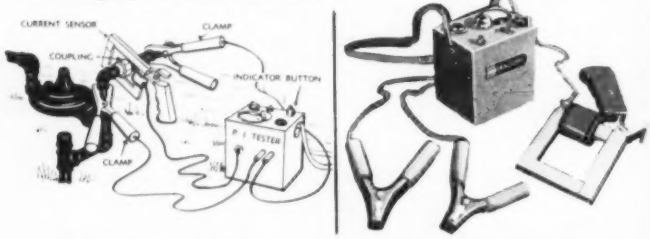
Good-All

PIPE INSULATOR TESTER

SIMPLE • FOOLPROOF • ACCURATE

In a few minutes anyone can be taught to use the P. I. Tester and can check dozens of unions or flanges in a day. It will quickly pay for itself in man-hour savings and system improvement. The P. I. Tester will accurately check insulators in gas service entrances, oil field flow lines, refinery piping or other piping systems where alternate current paths make other methods of checking insulators unreliable.

FEATURES: Transistorized amplyfying circuit • Light, compact, rugged • Easy to read meter • Basic unit takes accessories for checking pipe of various diameters



Ask Your Good-All Representative For A Demonstration

GOOD-ALL ELECTRIC MFG. CO.
ELECTRICAL MECHANICAL DIV. OGALLALA, NEBRASKA

You're Money Ahead to
MEASURE PIPE PROTECTION WITH A CALENDAR

How should pipe protection be measured? By first cost? By ease of application? By appearance?

With all the claims made for protective tapes, too often the most important consideration is overlooked—the simple point of how long and how well it will protect the pipe.

Since 1941, when TAPECOAT originated coal tar coating in tape form, this protection has proved to be the best that money can buy for combatting corrosion underground or under water. Lines in service, TAPECOATED as far back as 17 years ago, show no signs of deterioration —a record of uninterrupted performance *no other type of tape can match.* Think what this means in terms of preventive maintenance and elimination of replacement costs!

After all, hot-applied coal tar has proven over the years to be the most dependable and enduring protection. And because TAPECOAT is a hot-applied coal tar coating in tape form, it offers the same lasting protection.

A TAPECOAT sales and service engineer is available at all times to assist you on any corrosion problem and on the various applications of TAPECOAT.

Write for complete details today.

PROVED IN SERVICE

...Underground or Under Water on

Pipe	**Tanks**
Pipe Joints	**Tie Rods**
Service Connections	**Conduit**
Mechanical Couplings	**Cables**
Fittings	**Splices**
Insulated Lines	**Bridge Crossings**

TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths—sized to the job. Available also in asphalt. Where primer is desired, specify TC Primecoat, the compatible coal tar primer.

TAPECOAT®

A PROTECTIVE COATING

The **TAPECOAT** *Company*

1535 Lyons Street, Evanston, Illinois

Representatives in Principal Cities

Manufactured and Distributed in Canada by The Tapecoat Company of Canada, Ltd., 25 Haas Road, Rexdale, Ontario.

J. G. Dickinson
NGPL

Keith Bentz
NGPL

C. B. Randall
NGPL

F. P. Burns
NGPL

chief engineer since 1956, first joined Youngstown in 1917 as a draftsman in the engineering department. Lucas joined the company in 1946 as a detailer.

WILLIAM P. HAHN has been appointed to the new post of technical manager of Johns-Manville Fiber Glass Inc., Toledo. With J-M since 1936, Hahn most recently was assistant manager of the industrial insulations research department.

Five organizational changes affecting both Chicago and Amarillo officers have been announced by Natural Gas Pipeline Co. of America, Chicago. J. G. DICKINSON, Amarillo, was elected senior vice president. Three vice presidents named are KEITH BENTZ and C. B. RANDALL of Chicago, and F. P. BURNS, Amarillo. J. M. DURRETT, Amarillo, was named assistant secretary. Dickinson has been an NGPL vice president since 1949; Bentz has served as assistant vice president of operations; Burns as assistant vice president of production; Randall as director of tax and insurance. Durrett has been Amarillo office manager.

FRED O. SNYDER has been appointed manager of Worthington Corp.'s district sales office in Cincinnati. He succeeds RALPH G. GRIFFIN, who has transferred to the company's Harrison, N. J. office.

Undisputed Champion!

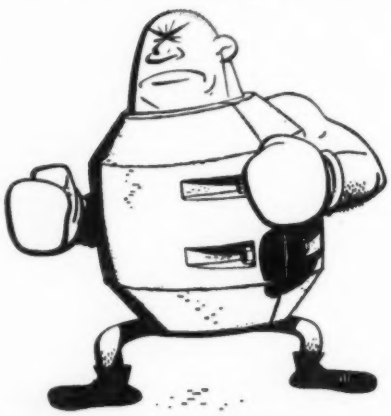
Allan Edwards

HEAVYWEIGHT

RIVERWEIGHTS

PUT YOUR

PIPELINE



. . . DOWN FOR KEEPS

Allan Edwards, Inc., is the nation's oldest manufacturer of concrete river-weights. Weights are carefully designed and constructed to meet individual requirements. Weights can be constructed at your jobsite if tonnage warrants. Other fine Allan Edwards pipeline specialty products include . . .

WELDING SLEEVES • HALF SOLES • MARKER POSTS

Allan Edwards, Inc.

2445 S. Jackson—P. O. Box 7218, Tulsa, Oklahoma

Washington • *Cont'd.*

from page 21

sorb the gas from Transwestern in view of El Paso's own expansion plans. This request was denied, as was an alternative request from El Paso that its bid along with related expansion plans of Pacific Northwest Pipeline and Colorado Interstate Gas be consolidated with the Transwestern proposals.

Granting either of El Paso's requests would result in an "unconscionable delay" of the Transwestern proceedings, the FPC ruled.

With this, El Paso filed a competing plan to Transwestern's under which El Paso would build a $47 million pipeline to the Arizona-California border to deliver an additional 100 MMcf a day to Pacific Gas & Electric at an existing delivery point to serve the same areas Transwestern is bidding for. El Paso had earlier said it does not oppose the Transwestern project.

El Paso had already applied, along with Pacific Northwest and Colorado Interstate for permission to build a new line to deliver up to 470 MMcf to the California-Nevada border for use primarily in northern California. This earlier application was the one that promoted El Paso to seek a market survey or a consolidation of cases.

The market feud betwen Transwestern and El Paso over the California market is obvious. (See Pipeline News for more on Transwestern vs. FPC.)

THE giant American Telephone and Telegraph Co., which for some years has been trying to get out from under provisions of an antitrust consent order, should have been treated much tougher in the first place, according to some congressmen.

The giant communications utility never should have been permitted to enter into the consent agreement, the Democratic majority of the House Antitrust subcommittee complained recently in a massive report.

Gas and oil firms, particularly gas pipelines and distributors, over the past two years have been fighting with AT&T before the Federal

Communications Commission over microwave facilities.

In a consent decree, the Justice Department's trustbusters and the company against which antitrust charges have been brought worked out a settlement, under which the firm agrees to the government's restrictions on its operations. The judgment then is filed in court and has the weight of a court order.

Under one provision of the AT&T consent decree, AT&T was prohibited from expanding in any field which was not regulated. This included its lease-maintenance of stationary and mobile standard and microwave radio communications equipment.

In order to get around this provision, the AT&T attempted to file tariffs for this lease-maintenance service with the Federal Communications Commission. If they had been accepted, it would have become a regulated field, and thus the communications utility could have expanded almost at will. The Justice Department opposed the AT&T move, and eventually the firm withdrew and proposed to end all such services.

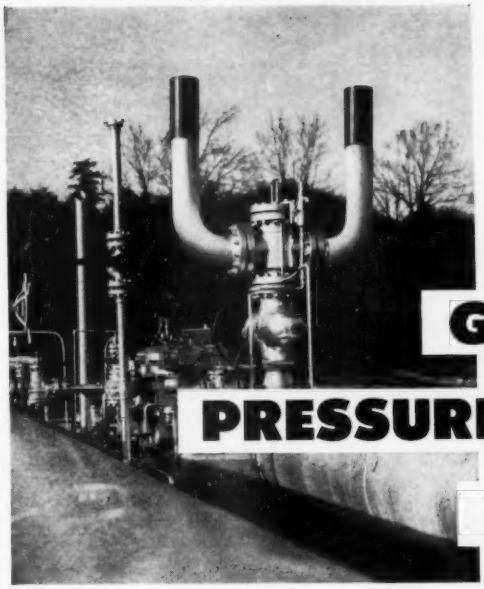
The House Antitrust subcommittee, headed by Rep. Emanuel Celler, (D., N. Y.), is sharply critical of the Justice Department for permitting AT&T to sign the consent judgment. Rep. Celler contends that the resulting restriction on the firm was softer than would have been the case had a court decided all the issues.

At the same time, the subcommittee also blasted the government trust busters for using the same consent procedure in dealing with the major oil pipelines—the largest transporters in the country.

The department brought antitrust charges against the pipelines in 1940, alleging restraint of trade in violation of the Elkins Act. One charge involved shipper rebates.

The attack on the Justice Department, the oil pipelines, and AT&T, however, brought sharp cries of "smear," "bias," and "politics" from Republican members of the subcommittee as well as the firms involved.

In spite of the bitterness of Rep. Cellers' attack, there is little likelihood of either new legislation or reopening of the old court cases involving the two consent decrees.



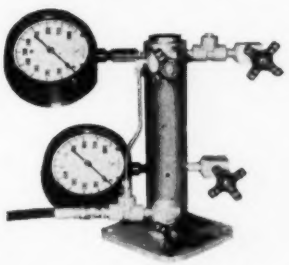
GARRETT
PRESSURE RELIEF
VALVES

REDUCE COSTLY
SHUT-DOWN TIME!

HERE'S HOW:

Without removing the valve body from the line, the set pressure and re-set pressure of a Garrett Relief Valve may be checked in a few minutes time. Using the small, light weight Garrett Test Fixture, pressure from bottled nitrogen or other source, and regular hand tools, pressures may be checked or changed by field personnel, without special training.

This is another feature of Garrett Relief Valves which adds to the safety and economy of your operations.



The Garrett Test Fixture is simple to use, light and easy to carry, and completely accurate in operation.

FOR COMPLETE INFORMATION, WRITE FOR CATALOG NO. RV-103-A

USI Garrett Oil Tools
Division U. S. Industries, Inc.
P. O. BOX 2427 • LONGVIEW, TEXAS

— INDEX TO ADVERTISERS —

Th's advertisers' index is published as a convenience and not as part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors or failure to insert.

Adams Pipe Repair Products —
Aeroquip Corp., Marman Div. 50
Air Preheater Corp. 141
Allied Chemical, Plastics & Coal Chemicals Div. 28
Allis-Chalmers Mfg. Co. 35
American Cast Iron Pipe Co. —
American Meter Co. 94, 95, 106
American Meter Co., Reliance Regulator Div. Second Cover
Amercian Recording Chart Co. 86
American-Standard 105
Aqua Survey & Instrument Co. —
Arkla Air Conditioning Corp. 51, 107
Arrow Manufacturing Co. 152
Auburn Machine Works —

Barber-Greene Co. 56
Baso Inc. —
Berry Hydraulics Div., Oliver-Tyrone Corp. —
Bethlehem Steel Co. 138, 139
Bilco Co. —
Black, Sivalls & Bryson, Inc. Third Cover
Blaw-Knox Co. —
Bonded Products Inc. —
Bonney Forge & Tool Works —
Bristol Co. —
Browne Mfg. Co., Stewart R. —
Bucyrus-Erie Co. 37
Burgess-Manning Co. —
Burroughs Corp., ElectroData Div. —
Busada Supply Co., Inc. —
Byers Co., A. M. —

Capitol Mfg. & Supply Co. —
Cast Iron Pipe Research Assn. 54, 55
Cathodic Protection Service —
Chaplin-Fulton Mfg. Co. 36
Cleveland Trencher Co. 87
Connelly, Inc. —
Controls Co. of America —
Cooper-Bessemer Corp. 146, 147
Coast Paint & Lacquer Co. —
Cosa Corp. 107
Crose Mfg. Co., M. J. —
Cutler-Hammer Inc. 33

Darling Valve & Manufacturing Co. —
Davey Compressor Co. —
Day Co., S. D. —
Dollinger Corp. —
Dover Corp., Peerless Mfg. Div. —
Drake & Townsend Inc. —
Dresser Industries, Inc. —
Clark Bros. Co. —
Dresser Manufacturing Div. 84, 85
Roots-Connersville Blower Div. 7

Eastman Chemical Products —
Ebasco Services, Inc. 40
Edwards Inc., Allan 156
ElectroData Div., Burroughs Corp. —
Electro Rust-Proofing Corp. 101
El Paso Natural Gas Co. —
Emhart Manufacturing Co. Maxim Div. —

Fish Engineering Corp. —
Fisher Governor Co. 26, 27
Fisher Research Laboratory, Inc. 108
Flexonics Corp. —
Ford Motor Co. 62
Foxboro Co. 134, 135

Garrett Oil Tools, Inc. 157
Gas Equipment Manufacturers Committee —
General Controls —
Glidden Co. 52
Good-All Electric Mfg. Co. 154
Goodrich Chemical Co., B. F. 58
GPE Controls Inc. 145
Grabler Manufacturing Co. 14
Grayson Controls Div., Robertshaw-Fulton Controls Co. 24, 25
Grove Valve & Regulator Co. 46

Hallen Construction Co., Inc. —
Handley-Brown Co. 29
Hardwick Stove Co. —
Hays Manufacturing Co. 103
Heath Survey Consultants Inc. 108
Hill, Hubbell Co. 59
Homestead Valve & Manufacturing Co. 53
Houston Contracting Co. —

Ingersoll Rand Co. —
International Business Machines Corp. —
International Harvester Co. 13

Jaeger Machine Co. —
Johns-Manville Corp. 142, 143
Jones & Laughlin Steel Corp. —

Ka-Mo Tools Dept,. Kwik-Mix Co. —
Kimray Inc. —
Koenig Iron Works, Inc. —
Kraloy Plastic Pipe Co., Inc. 57
Kwik-Mix Co., Ka-Mo Tools Dept. —

Laclede Steel Co. —
Ladish Co. —
Lancaster Meter Parts Co. —
Ledeen Manufacturing Co. 4
Lone Star Steel Co. 3

Maloney Co., F. H. 140
Manufacturers Engineering & Equipment Corp. —
Marman Div., Aeroquip Corp. 50
Mavor-Kelly Co. —
Maxim Div., Emhart Manufacturing Co. —
Maxitrol Co. 10
May Products Inc. —
McCabe-Powers Body Co. —
McDonald Mfg. Co., A. Y. 105
Midwestern Pipe Line Products Co. —
Minneapolis-Honeywell Regulator Co. 17-20
Minnesota Mining & Mfg. Co. 30
Motorola Communications & Electronics, Inc. —
Mueller Co. 1, 45

National Tank Co. 110
National Tube Div., U. S. Steel Corp. 153
Natural Gas Odorizing Inc. 44
Naugatuck Chemical Div., U. S. Rubber Co. —
Nordstrom Valve Div., Rockwell Manufacturing Co. 38, 39
Norton-McMurray Manufacturing Co. 102

Oliver-Tyrone Corp., Berry Hydraulics Div. —
Onan & Sons, Inc., D. W. —
Oronite Chemical Co. 9

Parkhill Truck Co. —
Parsons Co. —
Peerless Manufacturing Co. —
Peerless Mfg. Div., Dover Corp. —
Perrault Equipment Co. —
Philadelphia Gear Corp. —
Pipe Line Service Corp. —
Pittsburgh Coke & Chemical Co. 137
Polyken Products Div., Kendall Co. 150, 151
Pritchard & Co., J. F. —
Production Plating Works Inc. 99

Radiator Specialty Co. 106
Reed Manufacturing Co. —
Reliance Regulator Div., American Meter Co. Second Cover
Remco Corp. —
Republic Steel Corp. 48, 49
Reynolds Gas Regulator Co., Inc. 104
Ridge Tool Co. 100
Robertshaw-Fulton Controls Co., Grayson Controls Div. 24, 25
Thermostat Div. 42, 43
Rockwell Manufacturing Co. Gas Products Div. Front Cover
Instrument Div. —
Nordstrom Valve Div. 38, 39
Roots-Connersville Blower Div. Dresser Industries, Inc. 7
Royal McBee Corp. 32
Royston Laboratories Inc. —

Safety Gas Main Stopper Co. 99
Seamless Rubber Co. —
Security Valve Corp. —
Sherman Products Inc. 5
Skinner Co., M. B. 41
Smith Corp., A. O. —
Smith Manufacturing Co., A. P. —
Somerville Construction Co. —
Southern Cross Foresters 94
Southern Pipe Div., U. S. Industries 96, 97
Sprague Meter Co. Fourth Cover
Stafford Co., R. W. 108
Standard Electric Time Co. —
Standard Magnesium Corp. 98
Standard Pipeprotection, Inc. 149
Sun Shipbuilding & Dry Dock Co. —
Superior Meter Co. 47

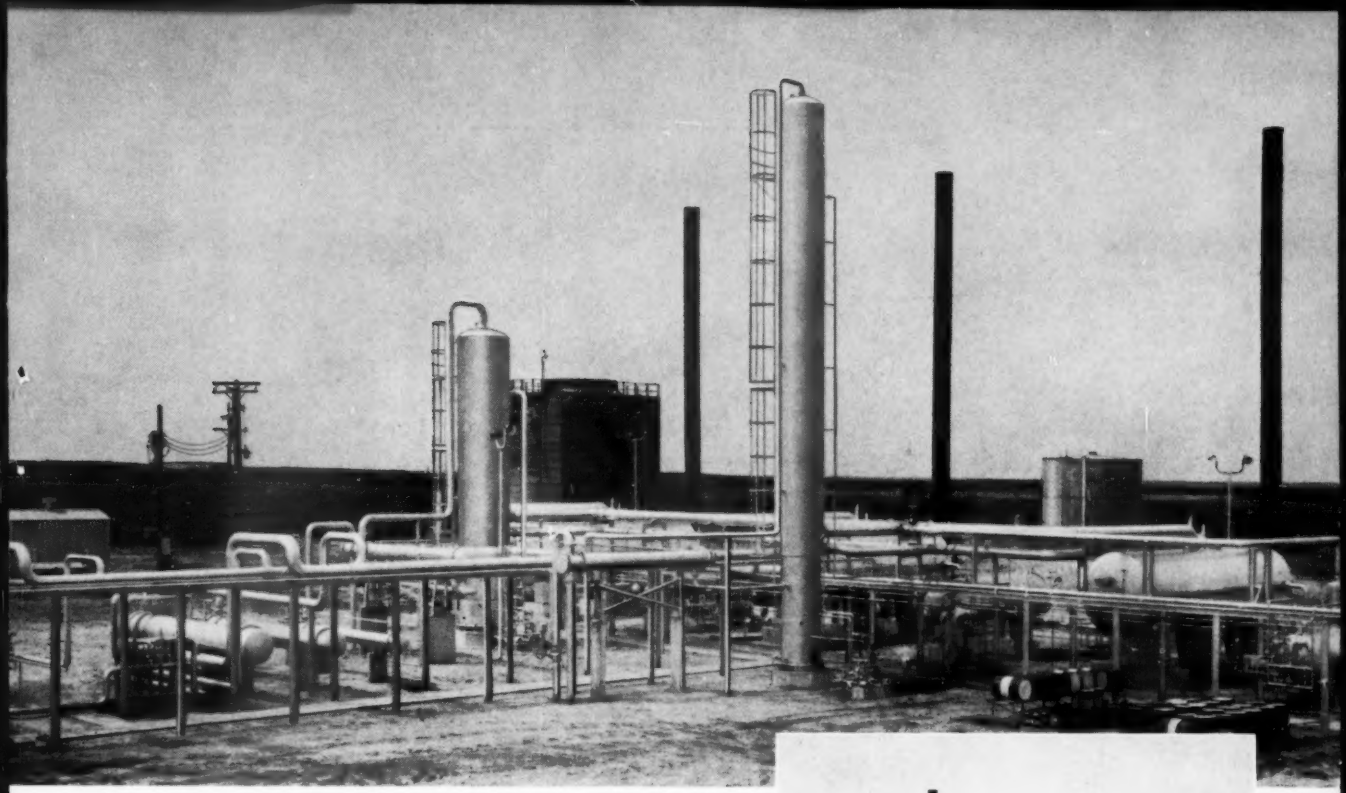
Tapecoat Co. 155
Taylor Forge & Pipe Works —
Tennessee Gas Transmission Co. —
Tex-Tube Inc. 57
Thermac Co. 31
Tinker & Rasor —
Transcontinental Gas Pipe Line Corp. —

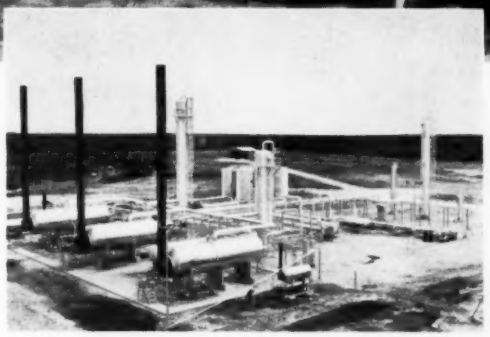
Union Malleable Mfg. Co. 22
Union Switch & Signal Div. Westinghouse Air Brake Co. —
United Engineers & Constructors —
U. S. Industries Garrett Oil Tools Inc. 157
Southern Pipe Div. 96, 97
U. S. Pipe & Foundry Co. 16
U. S. Rubber Co., Naugatuck Chemical Div. —
U. S. Steel Corp., National Tube Div. 153
Universal Controls Corp. 108

Vermeer Manufacturing Co. —
Vulcan Rubber Products, Inc. —

Walworth Co. —
Warren Petroleum Corp. 106
Westinghouse Air Brake Co., Union Switch & Signal Div. —
White-Rodgers Co. —
Wilcolator Co. 60, 61
Williams Pressure Service Co. —
Williamson, Inc., T. D. —
W-K-M Div., ACF Industries Inc. 133
Wood Co., John —
Worthington Corp. 128, 129

Youngstown Sheet & Tube Co. —





Split-Flow Design Desulfurization-Dehydration Plant . . . By BS&B!

From the very first moment the George H. Coates Desulfurization-Dehydration plant in Fashing Field, Atascosa County, Texas, went on stream, it has operated efficiently and well without the slightest difficulty or trouble. Desulfurization is accomplished by means of a monoethanol amine solution, and dehydration by a glycol solution.

Here are some points worth noting about the plant and its operation:

1. Incoming gas of 10% acid gas content is "purified" to sales gas containing only .25 grains of sulfur per 100 SCF.
2. Sales gas is dehydrated to pipeline specifications.
3. Volume of sales gas handled is 16.6 MMSCFD at 1100 psig.
4. Split-flow design greatly reduces fuel gas consumption.
5. This unit does *not* require the use of steam for heating.

If you have a "sour" gas problem on your lease, your BS&B Man will be glad to work out details with you for a similar installation tailored to your requirements. Why not call him today!

BS&B

ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

DEPT. I-BQ7, P. O. BOX 1714, OKLAHOMA CITY

BE SURE YOUR METERS ARE

EASY TO MAINTAIN

COMBINATION METER AND REGULATOR

BE SURE TO SPECIFY Sprague

The remarkably simple but dependable mechanism of the Sprague Meter saves you money two ways — First, you seldom need to make repairs because of Sprague's unique operating principle which practically eliminates wear. Second, Sprague simplicity makes servicing extremely easy — cuts your equipment and labor costs — speeds maintenance operations.

Start now to save money on maintenance and moderization. Be sure your meters are the easiest to maintain — be sure to specify Sprague.

Call or write your Sprague representative today.

The Sprague Combination Meter and Regulator is a compact dual-purpose unit which dependably regulates gas pressure and accurately measures the flow. It is neater looking, more efficient, and requires 60% less space than conventional arrangements.

The Combination is especially easy to maintain and inspect because of its basic simplicity and few moving parts. It will also save you considerable labor and material expense on conversion to a higher pressure system. Available in Iron Case or Aluminum Case. Sizes 175 & 240 cu. ft. Synthetic or leather diaphragms.

GEM

Sponsor of
"PLAYHOUSE 90"
on CBS-TV

THE Sprague METER COMPANY • BRIDGEPORT 1, CONN.

WESTERN BRANCH — LOS ANGELES 23, CALIF. REGIONAL OFFICES — DAVENPORT, IOWA • HOUSTON 3, TEXAS • SAN FRANCISCO 11, CALIF.